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STEPHEN H. GODDARD . . . . . VICE-PRESIDENT
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
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THE PENNSYLVANIA ELECTRIC ASSOCIATION.

At the Chicago convention, last May, of the National Electric Light Association, various amendments to the constitution and by-laws were adopted. One important amendment was to the effect that upon application of five Class A members, or two-thirds of all the Class A members, if less than eight, in any state, territory or dependency of the United States or provinces of Canada, the executive committee should authorize the applicants to organize a geographic section of the National Electric Light Association, to which all members of the association in such geographic section should be eligible for membership. When this amendment was adopted it was hardly expected that it would have a working out in a very short time. It is, therefore, at once a matter of congratulation and anxiety that the members of the Pennsylvania Electric Association, which held its first annual convention at Eagles Mere, Pa., last week, unanimously voted to reorganize as a state branch of the National Electric Light Association.

If we mistake not, the idea in the minds of the original members of the Pennsylvania Electric Association was that the national body should be supplemented by a distinct state organization, which organization would necessarily be in entire sympathy with the requirements of the corporations doing business in the state of Pennsylvania, and would be effective to a greater degree statewise than the national organization could possibly be. The presence of the very capable president and several members of the national organization, and the assistance which they were undoubtedly able to render in formulating plans for the development of the state organization, unquestionably made it easy to decide to become part of the greater association, rather than go it alone. The tremendous impetus which the National Electric Light Association has proved itself to be is a matter of immediate concern to every public-utility corporation interested in the supplying of electricity for light and power.

The working out of the present situation will be watched with a great deal of interest, as in almost every state in the Union where there is a state organization, a large number of the members are also members of the national organization. The amendment just discussed, if its advantages are properly applied, will work greatly to the benefit of the member companies, in that it will eliminate a great deal of organization and routine work which, if carried on by a central bureau, would tend to considerable economy, would make effective the strength of all for the benefit of each, and at the same time interfere very little, if at all, with the autonomy of the state organization.

WOOD PRESERVATION.

During the last four or five years the United States Department of Agriculture has given a great deal of attention to the matter of wood preservation, and its files contain much documentary evidence of the value of the research and experimentation which have been carried out along these lines, both here and abroad. A recent publication, circular 139, is a very interesting treatise on the subject of wood preservation, by W. F. Sherfesee.

We are familiar with the ordinary forms of decay which affect organic and inorganic matter. The decay of a plant body such as wood is not an inorganic process like the rusting of iron or the crumbling of stone, and is at the same time different from the process of decomposition of organic structures. It is due to the activities of low forms of plant life, called bacteria and fungi. Fungi, although more complicated than bacteria, are almost as low in the scale of creation when compared with familiar flowering plants and shrubs. The bacteria often consist of but a single cell, microscopic in size. Sometimes several such cells are attached to each other, forming a thread or filament. They multiply by the division of the parent cell into other cells, which, in turn, divide again. Fungi consist merely of tiny threads or hyphæ, which are collectively known as the mycelium. In the higher forms of fungi these mycelium form compact masses of tissue, such as are evidenced by the "punk" of rotting logs or the brackets formed on the trunks of growing trees.

The fruiting of these bodies themselves is not the cause of the decay in wood. Spores, which are very primitive substitutes for seed, and which are borne in the countless compartments into which the under surfaces of the fruiting bodies are divided, are produced in infinite number. When seen in bulk they appear as dust, and, like dust, are carried by the wind and strike all portions of the surrounding objects. Fortunately, few species of fungi successfully attack healthy living trees, and only a comparatively small number attack and destroy wood; yet the spores of some find a lodging in dead portions of a tree or in cut timber, and if the wood is moist and in the right condition for the spore to grow, it germinates and sends out a thin film-like white thread, which, by repeated branching, penetrates the entire structure of the wood.

It is well known that wood is composed of minute cells, the chief material of the cell walls being a substance called cellulose. Around these walls there are encrusted many different organic substances, known collectively as lignin. Most wood-destroying fungi destroy only the lignin; others attack the cellulose alone, while a third class destroys all parts of the wood structure. The lignin and cellulose are dissolved by certain substances secreted in the fungi, and thus serve as food for the fungus growth. Finally, the composition of the wood is so greatly changed that its strength is diminished, the texture becomes brittle and disconnected, and the wood is said to be "rotten."

In addition to the wood food, the fungus requires, however, for its growth and development, heat, air and moisture. If any one of these is lacking the fungus can not develop. We can not deprive the growing plant or the cut timber of heat, and only where the wood is sunk under water at great depths can we deprive it of air. Of the four requirements, therefore, these two are beyond control. It is only by depriving the fungi of moisture or of food that the destruction they cause can be prevented.

Seasoning of timber, which means practically that a certain percentage of the moisture contained has been extracted, adds greatly to the structural value of cut timber; but seasoned lumber is hygroscopic, and can reabsorb a considerable amount of moisture content from which it has once been freed. Of course the climate has a great deal to do with the content of moisture contained in standing timber.

The strength of partially seasoned timber, other things being equal, increases as the amount of moisture it contains decreases. Thoroughly seasoned timber of small sizes is sometimes three or four times as strong as the same timber when green.

It is a mistake to suppose that the germs of decay are inherent in a wood, and several processes for the preservation of wood have failed because they have been founded on this false assumption. The wood-destroying agencies start from the outside, and this explains the partial efficacy of certain paints, which merely form a superficial coating over the surface of the timber, but which are poisonous enough to prevent the spores from germinating. An exterior coating, secured by dipping a post into a thin solution or other material that will harden on the timber, for this reason is not a thoroughly effective protection, because, with shrinking or swelling of the wood, cracks form, through which the agents of decay enter.

Of the processes employed for the treatment of timber with antiseptics, those known as the zinc-chloride treatment and the creosote treatment are generally in common use. These antiseptics are applied by what may be called the pressure-cylinder method, the open-tank method and the brush method. In the pressure-cylinder method the timber is placed in a strongly made cylinder and subjected to heating by steam under pressure. The steam is withdrawn, and a high vacuum established in the cylinder; then the preservative compound is forced into the wood in the cylinder under pressure. After remaining under this influence for a certain time, the lumber is withdrawn from the cylinder and stacked in the open air. In the open-tank method the wood is first thoroughly seasoned by either air or kiln drying, and immersed in a hot bath of the preservative contained in an open tank. The hot bath is continued for a certain time, the moisture and air in the timber passing off in the form of bubbles. At the end of the hot bath the timber is immersed as quickly as possible in a cold preservative, which causes the contraction of the air and moisture remaining in the wood, creating a partial vacuum in the wood cells, which can be destroyed only by the entrance of the preservative. In this way atmospheric pressure accomplishes that for which the artificial pressure is used in the other commercial processes. In the brush method the antiseptic is painted on the surface of the timber, the liquid being applied ordinarily with a common paint brush. In this method care must be taken to check all knots and

excoriations, as the liquid can penetrate but a short distance into the wood. This process is, of course, not as thorough as either of the other two, but is of great value where the amount of timber to be treated is too small to justify the erection of a small treating plant, or where the land is so rugged that it is impracticable to transport the timber for even short distances.

From such tests as have been made it appears that if proper care is observed in the treatment of timber, all danger from injury from excessive temperatures can be avoided. The amount of moisture remaining in the wood is of greater importance. Creosote retards both the absorption and evaporation of water; hence its presence in thoroughly seasoned wood exposed to humid conditions tends to conserve its strength; whereas, on the other hand, if it is applied to green wood, the strengthening action of water evaporation is retarded. Zinc chloride and the other preservatives which are in water solution have a wholly different effect. Unless the wood structure is already filled with moisture to the point of saturation, more water is injected into it with the preservative, with the result, if the wood is partially seasoned, of decreasing its strength. The original strength of the wood, however, may be regained by seasoning.

The principal point of superiority of creosote as an antiseptic lies, apparently, in its insolubility in water. Once injected into timber it will not wash out. On the other hand, zinc chloride is much cheaper than creosote, and is shipped more easily, and with lower freight charges; but, since zinc chloride is soluble in water, timber treated with it, when exposed to moisture, will lose its preservative through the leaching out of the chloride; hence zinc chloride is used in comparatively dry situations. Creosote, moreover, is one of the few preservatives within commercial reach that offer absolute protection against the marine borers which work havoc among the wharves of the Atlantic, Gulf and Pacific coasts.

The actual saving due to wood preservation has been demonstrated time and time again, and actual figures have been presented before technical societies within recent years, and are available from the files of the United States Department of Agriculture. The question may be raised whether it can positively be proved that the treated poles will last twenty years. The author holds that a sufficient answer to this argument is that the poles need last only 1.6 years longer than untreated poles in order to justify the cost of treatment. But evidence of the value of preservative treatment is not lacking. It is only a few weeks ago that a contracting company, while installing a twenty-four-duct run for the Empire City Subway Company in New York city, owing to realignment necessary from the excavation work for the Hudson River tunnels, unearthed a block of creosoted conduit which had been under ground since 1887. After twenty-one years it was sound and without the least sign of decay. This conduit has been stored, as it was taken up without breakage, and is now on exhibition in the New York office of the company which manufactured it and laid it in the earth almost a quarter of a century ago.

STREET-LIGHTING CONTRACTS AND THE TUNGSTEN LAMP.

Nowhere in the field of electric lighting has the influence of the tungsten lamp been more directly felt than in street illumination. The increased efficiency and excellent life records which are being maintained by the series tungsten lamp in commercial service are attractive enough to the central station to offset the higher cost of each unit and the supplying of a much larger quantity of light for the same price. The essential features of the tungsten lamp ought to be made perfectly clear, however, to municipal officers and bodies influential in the drawing up of contracts, for there is an excellent opportunity for misunderstandings to arise in connection with the comparative efficiencies of carbon, metallized-filament and tungsten lamps if the lighting question is allowed to be settled for a term of years mainly on the basis of lamp economy.

Nothing is to be gained on the part of the central station by trying to minimize or even conceal the reduction in wattage which so distinguishes the tungsten lamp from its predecessors. A frank policy in this respect is worth everything, and no fair-minded city executive should begrudge a central station the benefits of enhanced lamp efficiency, provided the company makes clear that it is willing to share the benefits with the municipality. This it can do without resorting to prohibitive cuts in prices, provided the fact is borne in mind that the town or city is buying light, and assuming that the authorities are reasonable men, satisfied with a reasonable share in improvements which they risked nothing to obtain, and which they would never have enjoyed but for the willingness of the central stations to spend money on trials and experiments.

Local conditions must naturally in each case determine the rates charged for street lighting by tungsten lamps, but in view of the fact that in many instances the substitution of tungstens for carbon-filament incandescents gives the city an increase of from twenty-eight to sixty per cent in the volume of light emitted from each unit, with the added benefit of maintaining the initial candle-power far beyond the period when the gas-mantle lamp would be fit for respectable service and greatly in excess of the capabilities of the carbon lamp, there ought to be little justice apparent in a rate reduction when the new contract is made up on the tungsten lamp basis. Measuring the output of the series tungsten lamp in candle-power-hours one finds that the central station is giving quite enough to the municipal customer if it does not raise the rate per lamp per year, when the total candle-power-hours of other lighting units are figured. It is sometimes hard for the central station to convince the city authorities that the tungsten lamps will give enough better service to require no reduction in lamp rate, but there is a good chance in such cases to exhibit actual lamps which have burned a known number of hours, and let the non-technical city officials see for themselves the lasting characteristics of the old and the new units. Experience has proved, however, that the making of a new contract on the tungsten-lamp basis may result in a higher rate per lamp per year for the municipality, especially if a longer

burning is provided under the new conditions. In one case of this kind the price per year for twenty-five-candle-power carbon series lamps was $16.50 per lamp. When the contract expired a new contract was made upon the basis of thirty-two-candle-power tungstens, burning three hours per night longer during six months of the year. The new price per lamp was $19.30 per year, or an increase of seventeen per cent. Such an illustration of reasonableness on the part of the city officials in dealing with a problem of this character augurs well for other companies who approach the making of a new street-lighting contract with tungsten lamps as the working units, in a broad and far-sighted way.

MOTOR DRIVE FOR THE PRINTER.

Probably in no other industry has so much quiet experimentation been carried on in the adapting of motors to driving machinery as has been the case with the publisher and printer. Years ago, when the availability of the electric motor and automatic control for the driving of machinery was demonstrated, the printer was among the first to have the hardihood to install electricity as a source of power. Great were the claims made for the electric motor. The printer, by temperament, is an enthusiastic person, and rarely goes at things in a half-hearted way. Believing implicitly in the claims made by early solicitors he threw out his gas or oil engine and quarreled with his steam supplier, believing he had every one beaten at the start when he made up his mind to install an electric motor. Many and grievous were his disappointments. In most cases he either installed too much or too little power. Where the first condition prevailed, his bills for current were too high, and the service made but a poor showing against his previous costs for steam driving. Where the second condition prevailed, he was at his wits' end more than half the time because of the stalling of the motor and the disrupting of his circuits for a dozen different good electrical and mechanical reasons.

The printer was usually as enthusiastic in expecting the motor to do wonders as the early solicitor was to promise them. When figuring for power he rarely assumed that he would have all of his machines in operation at one time, and this, of course, was taken advantage of in the installation of his motor. As a matter of fact, however, every once in a while he would require all of his apparatus at one time, and machine after machine would be thrown on, until the belts would start to slip, and presently the motor or some part of the circuit would go out of commission. Then, again, in dispensing with his steam service he, in most cases, counted upon saving the engineer's wages. The foreman of a printing plant is usually a man of considerable intelligence and not a little mechanical ability, and upon him, in large measure, devolved the task of running the motor. While things were going smoothly he got along very well. When the motor commenced to cut up capers he, of course, secured all manner of advice from every one who had a smattering of knowledge more or less technical. It is easy to realize that with some of the earlier installations the motors did some truly wonderful things, carrying overloads which the most sanguine designers and manufacturers never expected them to be capable of. The usual method of curing a sparking commutator was the application of a rag well greased with vaseline. Where fuses were used it was only because they would not blow when they should have blown that the circuit remained intact, and that there was not more trouble is one of the things that can be explained only by the immutable perversity of inanimate objects.

The constant improvement in the design and manufacture of internal-combustion motors and the laying of mains through the streets by steam-distributing companies retarded considerably the introduction of the electric drive. These elements at the same time stimulated the electrical engineers and manufacturers to make a closer study of the needs of the printer, and the result has been that nowhere is the electric drive giving so much satisfaction at the present time as in the printing industry.

It must be understood that from very crude methods of simply closing a switch there have been evolved methods of automatic control which fit almost any possible demand which the printer may make. The adapting of automatic control to the perfecting presses used by the daily newspapers has made necessary the exercising of the greatest possible ingenuity and perseverance. An idea of the complexity of the circuits and the necessity for fine control in operating these machines may be gained from the article which is presented on another page of this issue by Mr. S. H. Sharpsteen. The author gives a very lucid idea of the two-motor drive with automatic control which is very successfully meeting the demand for a safe and reliable source of power.

In getting a perfecting press ready for production, the machine must be put through a series of movements which require a motor that will operate from the slowest possible crawling speed up to the high speed necessary for the rapid production of the daily newspaper whose circulation runs into the hundreds of thousands. Plates must be fastened on, paper threaded in, adjustments of every description made, all under control of the man in charge, and at the same time under control of men working at various parts of the press; for it must be understood that this is a machine of great dimensions, and quite a number of operators must be at work at different parts of the press at the same time. The method of push-button control has been elaborated, and yet so simplified that we rarely hear of an accident either to the machine or to the men operating it.

This is only one phase of the many applications of the motor drive and automatic control to printing machinery. There are numerous installations in the loft buildings all over our larger cities which form a fallow field for the electrical engineer and the designer of electric motors and control apparatus. The employing printer, through his trade societies, very quickly learns of the success with which a brother printer meets in the employment of any new device, and now that it has been demonstrated that the electric drive is a source of economy, he is anxious to take advantage of that economy, outside of his natural desire to have his equipment driven by the latest form of power-producing machinery.

THE STATEMENT OF OHM'S LAW.

BY MORTON G. LLOYD.

In 1826 G. S. Ohm announced the relation between electromotive force and current, which has ever since been regarded as one of the fundamental laws of electrical science. The law discovered by Ohm is that in a definite conductor of the first class,[1] under definite conditions, the current is proportional to the electromotive force which produces it, that is, to the total electromotive force in the circuit. It was applied by him to continuous currents, but it is equally true of conductors in which alternating currents are flowing. Since it is true of the instantaneous current it must hold also for values obtained by summation over a complete cycle.

Put into the form of an equation, using the usual symbols, Ohm's law becomes

$$\frac{E}{I} = \text{a constant.}$$

That is to say, if E be varied while all other conditions remain the same, the ratio $\frac{E}{I}$ remains constant. If some other condition, such as the temperature, be changed, I is again proportional to E, but the ratio has now a different value.

If e be the instantaneous impressed electromotive force in an alternating-current circuit, then we must combine with it the self-induced electromotive force, since Ohm's law applies to the total electromotive force. Thus $\frac{e - L\frac{di}{dt}}{i} =$ constant, where $\frac{di}{dt}$ represents the rate of change of current and L the inductance. If the circuit or conductor be coupled with a secondary circuit, there will be another component of electromotive force to be considered; thus

$$\frac{e - L\frac{di_1}{dt_2} - M\frac{di_2}{dt}}{i_1} = \text{constant.}$$

When we consider effective or maximum values in an alternating circuit supplied from a source of sinusoidal electromotive force, Ohm's law may still be applied if the inductance of the circuit be definite and constant (*e. g.*, free from iron). The equation then becomes $\frac{\sqrt{E^2 - L^2 p^2 I^2}}{I} =$ constant, where E is the electromotive force impressed on the circuit or conductor, and LpI represents the self-induced electromotive force.

[1] *i. e.*, metals, etc. Ohm's law does not hold in gaseous conductors.

If there be capacity in the circuit, its potential forms one component of the electromotive force which must be included in the equation. Thus for instantaneous currents, $\frac{e - L\frac{di}{dt} - \frac{q}{C}}{i} =$ constant, where C is the capacity and q the charge; and for the effective values with sinusoidal currents,

$$\frac{\sqrt{E^2 - I^2\left(pL - \frac{1}{pC}\right)^2}}{I} = \text{constant.}$$

When put into this form it is evident that Ohm's law holds for alternating currents, and the idea so often expressed that this law does not hold under these conditions is seen to be due to an erroneous point of view. Just as in the case of continuous currents, the value of the constant is changed whenever the conditions are changed, and here a greater variety of conditions may exist. Thus a variation of frequency, if the latter is sufficiently high, may alter the value of the constant, and in this case the variation of L with the frequency would have to be considered also.

The form which Ohm's law takes in the case of alternating currents is not one which is convenient for computation, and it is due to this fact that the formula involving the expression for impedance has taken its place in the discussion of alternating currents. But it should be borne in mind that the law of Ohm is just as true, for the law then takes on a greater significance.

It should be noticed that up to this point the word *Resistance* has not been used, and I want particularly to lay stress upon the fact that Ohm's law can be discussed without mention of it. Resistance is the name which has been given to the ratio $\frac{E}{I}$ in the case of continuous currents, and the practical units of measurement of the three quantities, electromotive force, current and resistance, have been so chosen that the numerical relation $\frac{E}{I} =$ R holds. When a change of temperature or other condition alters the ratio $\frac{E}{I}$ we say that the resistance changes, in order to keep intact the above relation.

Having defined resistance in terms of the conditions in a continuous-current circuit, it then becomes a matter of experience (or extension of definition) as to whether the same relation holds under other conditions, as, for example, with alternating current. As a matter of fact with sinusoidal currents the radio $\frac{\sqrt{E^2 - I^2\left(pL - \frac{1}{pC}\right)^2}}{I}$ is still called the resistance, and if the value of this ratio changes with the frequency, for example, again we say that the resistance changes, even though all the physical characteristics of the conductor remain unaltered.

Inasmuch as the conception of resistance is a consequence of Ohm's law, it does not seem desirable to use that term in the expression of the law, at least not in the way that it is so often stated, *viz.*: "The current is equal to the electromotive force divided by the resistance." The law is better stated, from the logical standpoint, by saying that the current is proportional to the electromotive force, or that their ratio is a constant.

The Annual Meeting of the American Electrotherapeutic Association.

The eighteenth annual meeting of the American Electrotherapeutic Association will be held in the Engineering Societies Building, 29 West Thirty-ninth street, New York city, on September 22, 23 and 24. The evening of September 23 will be devoted entirely to the exhibit of apparatus and appliances, which will be held in the large room on the fifth floor, adjoining the usual assembly room of the New York Electrical Society. The association has procured the use of the fifth floor for the three days' session, and the members of the New York Electrical Society, the American Institute of Electrical Engineers and engineers in general are invited to be present during the several sessions.

The Education of Street Railway Employés.

A committee has been appointed by President Goodrich, of the American Street and Interurban Railway Association, to study and report upon efforts which are being made by railway companies to train their employés for efficient service. This committee is composed of Professor H. H. Norris, chairman; R. E. Danforth, Newark, N. J., and Professor A. S. Richey. It is likely that the committee will present a preliminary report at the convention of the American Street and Interurban Railway Association, which will be held at Atlantic City, N. J., next month.

The Huddersfield (England) Municipal Street Railways.

The following statistics concerning the working of the Huddersfield street railways are furnished by Consul F. I. Bright:

"Huddersfield, embracing an area of 11,854 acres, has a population of 100,000 and a ratable value of $2,380,448. Probably in no other town in England of the same population is municipal ownership carried on to the same extent. It was the first city in England to own and operate its tramways.

"Steam was superseded by electric power in 1901. The system now has a little over twenty-eight miles of track, over eight miles of which are double track. Each of the seventy cars has a seating capacity for fifty-six passengers. The ordinary number in use is fifty-six, each running on an average 113 miles from 5 A. M. to 12.45 A. M. The passengers carried in 1907 numbered 16,130,334, at an average fare of 2.4 cents; the total miles run was 1,960,329. The 430 regular employés receive a weekly wage of $2,239. Motormen and conductors work nine hours a day; the shed staff, day, nine hours, and shed staff, night, seven and one-half hours.

"The cost of the permanent way has been $984,167, the total outlay for permanent works, cars, twenty-four waiting rooms, and other property being $2,009,383. An open top car weighing ten tons costs $2,579, a covered top car weighing ten tons fourteen hundredweight, $2,823.

"The total working expenses for the year were $202,943, making an average of 8.7 cents per car-mile, after deducting $31,486 for power expenses. The fares charged run from two cents per 1.23 miles up to eight cents per 6.85 miles.

"From 5 A. M. to 8. A. M. and from 4 P. M. to 10 P. M. cars are available to workmen going to and from work at fifty per cent of the ordinary fares.

"The total income for the last year was $412,212, leaving a gross surplus of $209,269, and, after paying certain amounts of interest on capital, redemption of debt, and depreciation account, a net surplus of $31,700 to be applied to the relief of the general rates.

"During the year there were 262 accidents, caused principally from collisions between cars and other vehicles and by passengers alighting from and boarding cars when in motion. There were no fatal accidents, and less than thirty claims for damages were presented. Third-party risks are covered by insurance, and all such claims are adjusted direct by the insurance company, which receives an annual premium of $3,626.

"There is a postal letterbox attached to each car, which is cleared every hour from 8.30 A. M. to 9.30 P. M. and again at 11 P. M. The number of letters carried in 1907 was 720,512.

"There is no thought here at the present time of adopting the motorbus, in use in a few large cities. The working expenses are regarded as too high."

Edison Electric Illuminating Company of Boston Establishes Illuminating Engineering Department.

The Edison Electric Illuminating Company, of Boston, Mass., has opened a department of illuminating engineering at its general office, 39 Boylston street, Boston. The Edison company has always been one of the foremost in inaugurating enterprising departures, and the company for many years has set the standard in its efforts to promote the use of electricity and give to its customers the advantages accruing from such service. The illuminating engineering department is under the direction of Dr. Louis Bell and H. W. Moses.

The number of customers of the Edison company in the twenty-five cities and towns in which it sells electricity has shown a steady increase during the past few years. On June 30, 1906, the company had 18,963 customers; in 1907 the total was 20,375, and in 1908, 21,719, an increase of six per cent over 1907, and of fourteen per cent over 1906.

BOOK REVIEW.

"Electrical Engineer's Pocketbook." Horatio A. Foster. New York. D. Van Nostrand Company. Flexible leather, gilt edges. 1,600 pages. 4¼ by 6⅞ inches. Supplied by the ELECTRICAL REVIEW for $5.

It has always been easy to say a good word for Foster's "Electrical Engineer's Pocketbook." Having praised previous editions so highly, it is difficult to find an expression which will appear commensurate with the greatly improved construction and quality of the present volume, which constitutes the fifth edition. Some idea of the value of the work may be gained if we repeat the enthusiastic comment of an engineer after examining the work carefully and critically. He said: "This is the last word in electrical handbooks."

The work has been divided into a number of sections, and each of the sections has been revised by a specialist eminent in his particular field. The value of such revision can not be gainsaid when the weight of such authority is attached to the revision. The list of contributors includes the following: Symbols, Units, Instruments—W. N. Goodwin, Jr., and J. Frank Stevens; Measurements—W. N. Goodwin, Jr., and Professor Samuel Sheldon; Magnetic Properties of Iron Electromagnets—Townsend Wolcott and Professor Samuel Sheldon; Properties of Conductors and Properties of Conductors Carrying Alternating Currents—Harvey Pender; Dimensions of Conductors for Distribution Systems, Harvey Pender; Dynamos and Motors—Cecil P. Poole and E. B. Raymond; Tests of Dynamos and Motors and Alternating-Current Machines—E. B. Raymond and Cecil P. Poole; The Static Transformer—W. S. Moody and K. C. Randall; Incandescent Electric Lighting—Dr. C. H. Sharp; Arc Electric Lighting—J. H. Hallberg; Illuminating Engineering—Dr. C. H. Sharp; Electric Railways—A. H. Armstrong, C. Renshaw, N. W. Storer and Milton W. Franklin; Electrolysis—A. A. Knudson; Transmission of Power—Dr. F. A. C. Perrine; Storage Batteries—Lamar Lyndon; Switchboards—H. W. Young, B. P. Rowe and E. M. Hewlett; Lightning Arresters—Townsend Wolcott; Electricity Meters—H. W. Young and J. B. Baker; Telegraphy—Charles Thom; Wireless Telegraphy—F. K. Vreeland; Telephony—J. L. Wayne; Electricity in the United States Army—G. H. Powell; Electricity in the United States Navy—J. J. Crain; Resonance—Lamar Lyndon; Electric Automobiles—C. J. Spencer; Electrochemistry and Electrometallurgy—Professor F. B. Crocker and Professor M. Arendt; X-Rays—Edward Lyndon; Electric Heating, Cooking and Welding—Max Loewenthal; Lightning Conductors—Professor Alex G. McAdie; Mechanical Section—W. W. Christie.

The section on resonance, by Lamar Lyndon, affords a particularly lucid presentation of this difficult subject, and the chapter on electric heating, cooking and welding, as well as the chapter on wireless telegraphy, brings down to date some very useful information for which there has been considerable demand within the last few years. The copious index and the thorough system of cross-indexing, together with the marginal thumb references, make the finding of information on any subject almost an instantaneous process.

Public Utilities in Germany.

Consul Thomas H. Norton, of Chemnitz, states that a recent statistical summary of the extent to which public utilities are now under the direct management of German municipalities shows that the movement is constantly gaining in momentum and that the field of activity is steadily being broadened. The consul's review continues:

"There are now fifty-eight cities in the Empire, containing over 50,000 inhabitants. In these cities the leading utilities are owned and conducted by the municipalities to the following extent:

Public Utilities.	Number of Cities.
Gasworks	44
Electric power plant	38
Waterworks	43
Abbatoirs	47
Bath houses	42
Street railroads	10
Removal of garbage and sewage	56
Market halls	16
Tenement houses (chiefly for municipal employés and laborers)	22

"In regard to financial results the gasworks make the best showing. Their total profits amount annually to $10,100,000. Of this sum about $2,500,000 is required for interest on the investment. Electrical works show a profit of $4,200,000, of which $1,300,000 is expended for interest. Waterworks return on an average 8.5 per cent of the capital invested. Market halls and tenements yield but little profit.

"The entire capital invested by German municipalities in plants for public utilities is now estimated at nearly $1,000,000,000. The value of forests and meadows, as well as the capital of municipal banks and loaning organizations, is not included in this total.

"While so much activity in this field is developed by the German cities, there is but little evidence of a tendency to invade indiscriminately the economic territory of general industrial competition. Municipal control is established when there is simply the choice between a public and a private monopoly, as in the case of gas, water, electricity, etc., or else when the desirability of a utility is unquestioned, but the uncertainty as to profitable returns fails to attract private capital. There is but little probability that German municipal enterprise will step outside these limitations.

"The telegraph and telephone in Germany are owned and managed by the Imperial Government, and most of the railway lines are the property of the different states."

Canadian Electrical Power.

In continuation of Consul Shepard's report, Consul A. G. Seyfert writes from Owen Sound that the hydroelectric power transmission plan from Niagara Falls to the towns and cities of western Ontario has at last reached the period when the contract for the erection of the line has been let. Mr. Seyfert continues:

"The total length of line to be built is 293 miles, with 3,176 steel towers. The contract calls for a main line from Niagara Falls to Dundas, with lines from the latter place to Toronto, London, St. Mary's and St. Thomas, and was let to a construction company for $1,270,000, the lowest of twenty-seven tenders, and includes all the lines in one contract.

"The head of the construction company is an American, who was formerly connected with some of the Canadian railways. The line as now planned covers only western Ontario, but there is an important concession clause in it for additional lines of equal length to cover eastern Ontario at any such time as the people of that section of the province may ask for the privilege of Niagara power.

"The contract will necessitate the use of 507 tons of aluminum wire, together with 140,000 pounds of telephone wire. The towers will be sixty-six feet high and consume 6,554 tons of steel to build them. The estimated cost of the towers is $621,000. The work is to be completed by December 1, 1909. The material for the construction of this gigantic electric power transmission scheme is to be Canadian-made as far as it is possible to secure it."

Rapid-Telegraphy Invention.

A report from Consul Joseph I. Brittain, at Prague, states that the European papers have been devoting considerable space to the invention of a Hungarian by which it is said the inventor may transmit 40,000 words per hour over a telephone line. The consul furnishes the following description:

"The machine consists of three parts: a perforator, transmitter, and receiver. The first may be worked by a typewriter, while the other two are automatic, working through the agencies of electricity and photography, and the instrument may be connected by an ordinary telephone line.

"Through operating the keys of the perforator the operator writes messages upon a long paper ribbon. By touching the keys a series of holes is punched in the ribbon, each set of holes representing a letter.

"After taking the ribbon from the perforator, the inventor places it in a small cylinder in the transmitter; and a touch of the switch sets the cylinder revolving and the ribbon with it. Before the ribbon has completely passed through the transmitter, a second broader strip of sensitized paper issues from the receiver, and upon it is written, in plain, legible characters, the actual message which the inventor or operator has written on the typewriter."

Wireless Telegraphy in Pacific.

Consul Julius D. Dreher sends from Tahiti the following information in regard to a network of wireless telegraphy which it is proposed to establish among the scattered islands of the Pacific Ocean:

"Capitalists who are interested in the extensive phosphate operations on Ocean and Pleasant islands of the Gilbert group, and in the new works about to be established on the island of Makatea of the Tuamotu Archipelago, have recently begun a movement to connect nearly all the groups of islands in the South Pacific by a system of wireless telegraphy.

"It is expected that the various governments having possessions in the South Pacific will aid in the establishment of the proposed system. Negotiations have already proceeded so far that the success of the efforts seems to be almost assured. As the nearest available ocean cable office to Tahiti is at Auckland, 2,250 miles away, from which a steamship of the Union Line of New Zealand arrives at Papeete once every twenty-eight days, and a direct communication by steamship of the Oceanic Company with San Francisco, 3,658 miles distant, is had once in every thirty-six days, it will be understood how deeply interested the French colony of Tahiti and its dependencies are in the complete success of these negotiations. Other groups of islands are equally interested in the establishment of this system, which means so much to the inhabitants of these widely separated archipelagoes.

"The name of the proposed company is the Pacific Islands Radio-Telegraph Company. Of the proposed capital of £70,000 ($340,000), the owners of the phosphate deposits on Ocean and Pleasant islands have subscribed £10,000. In this radial system there will probably be ten or twelve circles, the largest having a radius of 1,250 miles, and requiring for each station an engine of sixty horsepower. It has not yet been decided where the main office of the proposed company will be."

[Names of those interested in the enterprise may be obtained from the Bureau of Manufactures, Washington, D. C.]

TWO-MOTOR DRIVE—AUTOMATIC WEB-PRINTING-PRESS CONTROL.

BY S. H. SHARPSTEEN.

When the electric motor commenced to assume commercial shape the printing-press fraternity wanted electric drive. Standard motor parts, the result of years of the best electrical engineering development, were discarded and a poor special motor was demanded. Hand motor control for printing-press purposes was making good progress, when, to a great extent, the printer became interested in and purchased automatic control. Common business sense was the cause of discarding the special motor for one of standard manufacture, and possibly for the same reason much of the automatic electrical apparatus that is now found in the newspaper print shop will be discarded and more simple and durable devices used.

A newspaper web press is, as a rule, a large machine with very many parts. Adjusting, oiling, cleaning, repairing, plating, inking and threading in paper require men to work at its different parts at the same time. Because of the valuable space occupied in the business districts of large cities by these presses, the designing engineers are constantly decreasing the outside dimensions compared to the output of papers; the result is that pressmen have to do their work in close proximity to press parts that sometimes are still, other times moving slowly and often when the whole mass of moving gears and pinions is making a thundering noise and many tons of iron and steel shafts, drums and cylinders are revolving rapidly.

These conditions cause a demand for a means of stopping newspaper presses quickly from convenient places. Large sums of money have been expended for newspaper web-press control, but no device has been put into practical use for properly braking these machines. There are brakes that, when applied, retard the motion of the press, but they are used only in emergency on high-speed newspaper presses and are operated by a circuit of two small wires run around a press with push-buttons convenient for the men to use. This part of automatic or remote control is universally considered as good and proper.

The newspaper web-press builders and users are also of the opinion that automatic control from a number of convenient stations is proper for getting threading and plating speeds, a brake being used to stop the press as soon as a stop-button is pushed. Present methods of braking a web press automatically to stop it quickly are allowable when moving slowly for threading and similar work.

The newspaper man who is responsible for the lives of pressmen and the finances of a large paper—one who realizes the many tons of iron and steel that revolve at a terrific speed high up in the press-room and knows of instances when parts have come loose where certain presses were producing, these parts passing down between drums and cylinders—is inclined to place the production drive of his presses under the absolute control of a cool-headed person who has more than the ordinary mechanical ability.

When all-automatic control was first installed there was no objection to many buttons at each control station, but later, to dispense with costly complication of wiring and the trouble arising from pushing the wrong button when there were too many to select from, the number of buttons was reduced.

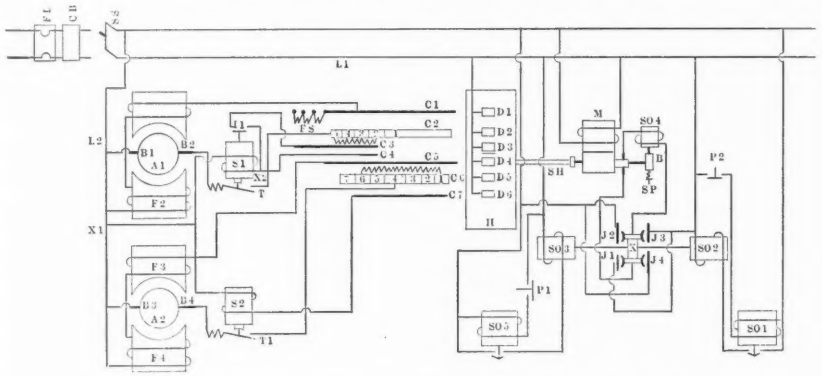
Certain recent installations have so few buttons at each station that large solenoid windings are closed when the main press switch is put in, thus reducing the cost of installation and the number of buttons at each station, but causing excessive use of current.

In newspaper electric drive and control each station usually contains at least four buttons or switches: one for speed ahead, one for slowing down or stop, one for emergency stop and brake and one for what is commonly called locking the press.

The diagram herewith illustrates two-motor drive with automatic control, A_1 being the armature of the larger motor, its circuit being opened and closed by a contactor, S_1. A_2 is the armature of the smaller motor, its circuit being opened and closed by a contactor S_2.

The movable part of the controller H is moved back and forth on guides by a motor, M, instead of swinging on a stud like the hand controller.

The motor M is shunt wound to produce as nearly as possible a constant speed as soon as its armature circuit is closed when running either way, its field being constantly excited when the main switch SS is in. The motor rotation is changed by reversing its armature current at the switch K, the solenoids SO_2 and SO_3 operating this switch. Assume that push-button P_2 causes the motor M to move the brush carrier H in the forward direction to start the large motor ahead. This button or switch can close a circuit to pass current around solenoid SO_2 or, since it might take more current to operate SO_2 than it would be advisable to carry about the press, the button P_2 could close the coil circuit of a solenoid switch, SO_1, this switch in turn closing the coil circuit of SO_2. When ready to start, pushing button P_2 would cause SO_1 and SO_2 to act as mentioned to force K against J_3 and J_4, passing current to release the solenoid brake SO_4 and turn the armature of M, which by means of the screw SH passes the controller brush carrier H to the left, first exciting the fields of the motors as brush D_1 touches C_1 and brush D_4 touches C_5. D_5 passing on to C_6 closes the armature circuit A_2 in the controller just before D_6 touches C_7, passing current through the coil of contactor S_2 and causing it to complete a circuit through the auxiliary armature A_2 and turn the press and large motor slowly. If a threading speed should be desired the button P_2 would be held down until D_5 reached point 4 on dial C_6, when the starting resistance would be out of circuit with armature A_2 and then released, opening the coil of SO_1, which would, in turn, open the coil of SO_2, releasing and allowing a spring to move switch K to



TWO-MOTOR DRIVE—AUTOMATIC WEB-PRINTING-PRESS CONTROL.

neutral position, thus not allowing current to pass through the armature of motor M and brake solenoid SO_4, dispensing with the power that moved the carrier H and applying a brake to the shaft SH at B, causing it to come to rest immediately.

After threading in paper, and production speed is required, P_2 is again held down, causing the motor M to move the carrier slowly to the left and when D_2 passes on to point 2 of dial C_2 the large motor armature circuit will be completed in the controller ready for the solenoid switch S_1 to pass current through the armature of the main drive when D_3 touches C_3 and C_4 making the final closing in the circuit of armature A_1 at T. For a short time both motors will be furnishing power to drive the press, but there being the proper amount of resistance in circuit with the large armature it will not increase the speed of the press too much at this point, and since the small armature is running in full field it soon ceases to increase in speed as the large motor takes the load. As the carrier H continues to move, resistance is cut out of circuit with the large armature, A_1, and in circuit with the small one, A_2, until D_6 leaves dial C_7, making contactor S_2 open, when the small motor comes to rest. The armature A is connected to the equipment by a ratchet device that permits it to drive but not to be driven. When the desired speed is reached P_2 is permitted to open, allowing carrier H to stand until some change in the press movement is demanded.

If it be desired to diminish the speed of the press, holding down push-button P_1 will cause automatic switch SO_5 to close a circuit and pass current through the coil of solenoid SO_3 forcing the switch K against J_1 and J_2, releasing the brake SO_4, and turning the armature in motor M in the reverse direction, pulling the brush carrier to the right.

When D_4 reaches C_5 the field of the small motor will be excited; later D_5 will touch point 7, dial C_6, and close its armature in the controller, and current will be passed to start this auxiliary machine when D_6 passes on to C_7 causing the contactor S_2 to close at T_1.

When D_5 reaches point 4, dial C_6, the small motor takes the load and all current is cut off from the large motor except, possibly, its fields.

Controller brush D_3 might be adjustable to allow moving to the right or left in the carrier H, permitting the contactor coil circuit S_1 to be excited to pass current at the proper time to close the circuit of armature A_1. For the same reason it would be convenient to have D_6 adjustable.

Point 4, dial C_6, should be long enough to allow the press to be brought to threading speed easily without starting the large motor.

Without a brake to stop the shaft SH when the buttons P_1 or P_2 are released, the momentum of the armature of motor M would possibly carry H beyond the desired point. Motor M being of small capacity the armature could be constructed to start on line voltage. The spring SP applies the brake, the solenoid SO_4 releasing it.

The coil circuit that operates contactor S_1 is connected with one side of the line L_2 at X_1, passes through S_1 and when brush D_3 rests on C_4 is also connected with the other line L_1 through C_4 and D_3. After D_3 touches C_4 and lifts the plunger in S_1, the coil in S_1 has a second branch circuit to D_3 commencing at X_2, passing through I_1 reaching D_3 through the strip C_3. As the brush holder H moves on to the left, D_3 leaves C_4 and opens the coil winding of S_1 that made it pick up the contactor lever and close the armature circuit of the large motor at T, but the exciting circuit of S_1 is kept closed by its auxiliary circuit. If the line current should be interrupted while the press is running for production the movable core in S_1 falls, opening the auxiliary circuit at I_1, the main circuit of S_1 passing through C_4, also being open in the controller; when the current comes on the line the motor armature circuit is open at T and can not be closed until H is returned to let D_3 touch C_4, when the small motor would have the press started and armature resistance would again be in circuit to prevent the large motor from producing too much torque.

Contactors are special devices for opening and closing motor circuits. They are made to rub hard to keep clean at point of contact and a magnetic flux forces out what might cause a burning arc. The controller brush carrier moves the brush slowly, giving an arc time to form and burn. The contactor opens and closes circuits quickly. As the contactor S_2 closes the small motor armature circuit during the reverse motion of H it can not have the usual auxiliary circuit, but since it only moves the press slowly and is of so small capacity, it could do a press no harm by producing extra torque if it were provided with the proper overload release device. The advisability of using a contactor to protect the small motor parts from burning is a question. It should at least have a circuit breaker, which would be the cheaper, saving complication in the brush carrier H.

If a contactor is used it should be supplemented with a fuse and an automatic overload device in the armature circuit of the small motor alone.

As the field-exciting current of the large motor has ample time to come up to full strength while the small motor is starting the equipment, it would seem that good practice would have it opened when the equipment was at rest, even though the service switch be closed. It will make the control a little more expensive but will save current and keep up the efficiency.

The field discharge of a large motor is severe on the insulation, but equipments can be constructed to stand it even though a special discharge path be necessary. Presses are sometimes at rest for hours with the service switch closed, and the current passing through the field coils of the motors is not only wasted but tends to keep up the temperature of the motors and the surrounding space. This heat is bad for the presses in hot weather.

As the auxiliary motor does not have to be reversed and [illegible] excited, economy demands that its fields be opened while the press is at rest and the switch closed and also while running for production, thus increasing the efficiency and keeping down the heat.

The contact brushes in the controlling devices and the points in the dials of printing-press control, even though they be the best, sooner or later require adjustment or repairs. The designing engineers of such apparatus have planned these parts so that they are difficult to remove and inspect. If an arm is used, as in manual control, the lift of the springs holding down the brushes causes a strain on the stud around which the arm moves. With automatic control if the brush is worked by gravity or solenoid and the contact pieces get slightly roughened, as often occurs, the brush refuses to move until overhauled. The controller brush carrier illustrated can be constructed to be held in line to prevent the brushes from rocking as the carrier moves. It will be easy to lift out for the inspection of the faces of the brushes, cleaning of the brush holders and to be replaced by an extra carrier if so desired.

The motor M should be designed to allow a large range of speed variation by field change. This arrangement will permit H to be driven to suit the press.

Provision should be made to have the

brush carrier H open the circuit of SO_2 at the extreme travel in one direction and SO_3 at the extreme travel in the other direction to prevent the motor M doing damage if a push-button refuses to operate or is held down too long by an employé. A flexible coupling between the shaft of motor M and screw SH designed to automatically disconnect these revolving parts in case of emergency is also good practice.

Controller brushes conducting the current from the movable controller parts to the dials or metal strips and blocks on controller faces or in automatic controlling devices do not always get the proper consideration. The right carbon or composition controller brush will not cut hard-drawn copper when moving with controller speed and proper brush tension. The brush, instead, gives the copper a smooth finish. It seems reasonable to say that only the best hard copper should be used for this purpose with provision for sufficient brush surface to guard against burn or arc oxidation even though several times the maximum running current might pass. A very large brush capacity compared to the current to be carried might be provided and still have the parts roughened and burned. The brush should be in two pieces at least, each piece provided with a spring, each spring having its own adjustment.

If the brushes are carried or moved by a holder, in which they are supported to feed down as they wear, this holder should be made of hard metal nicely trued and polished inside. The brushes should be accurately fitted to prevent jamming or binding and not loose enough to allow dirt to get between them and the holder. The deeper the holder the less liable the brush will be to tip and touch in a small spot only as it is reversed in motion. If the holder tipped back and forth at the ends of travel the brushes would tend to wear like rockers and present but a small surface to the dial. Pigtail brushes or a brush with a copper cable to be screwed fast to the brush rigging would be good, especially for armature circuits.

Armature resistance dial blocks, when packed solid with mica like a commutator, should have as good construction as a commutator, as they usually get hot from the heat conducted from the grids and if this change in temperature loosens the parts sparking and burning may follow.

If a newspaper web-press controller is what the electrical manufacturer can furnish, and the print shop should have, it will require no grease or vaseline between controller brushes and dials. Old-time controlling devices with copper traveling on copper usually require something to prevent cutting. When weight and space are very important, as in street railway work, this might do, but not in a first-class web-press equipment.

Since there are, in most cases with web-press electric drive, coils always in circuit when the main switch is closed, a switch should be provided with a means of operation that will induce the pressmen to keep it open when the press is at rest. If a good automatic switch, large enough to carry current for the equipment is installed, and its make and break controlled by a series circuit running around the press, and this circuit provided with a push-button switch at each control station, it would be an easy matter for the employé to open the line when the press is standing. Opening the coil circuit of this main switch by means of the small push-button switches at the different stations would answer for a lock, the station switches being in series, and an employé would be assured that the press could not be started if the lock was on at the station near where he was working.

If it were found advisable to place a small circuit-controlling device on the controlling panel to close and open the coil of the main solenoid switch, this smaller automatic switch could have its winding connected into a series circuit for press stations instead of that of the larger switch. The automatic switch and its auxiliary if placed in a cabinet with a glass front and locked up could not be operated by hand when the usual lock was on and some person working in the press. This main automatic switch could be designed to close a brake circuit when the line current was cut off the press equipment. The brake could be applied for emergency by the same buttons that were used for lock. If it were deemed advisable to have a separate button for an emergency brake to save confusion, the customary red push could be placed in the series-lock circuit that would answer for a quick shut-down. A first-class, double-pole circuit-breaker CB is the most reliable device to prevent a destructive in-rush of current in case of a metallic cross.

A breaker having a push-button release could be installed and arranged to close a dynamic or other break circuit instead of using the automatic switch for breaking purposes. An equipment with automatic main switch used for lock purposes and a circuit-breaker with a red button circuit both as above described would have three ways of bringing the equipment to rest: First, by the slow-down button which would take time to allow the brush carrier to come to off position; second, the lock button that would cut off the main current and allow the press to slow down without brake—this should be quicker than the first method of stopping; third, the red button to trip the circuit-breaker and apply the brake.

Some designers of motor-control apparatus might advise putting overload relays in circuit with contactor S_1 and armature A_1, also contactor S_2 and armature A_2, in place of using a circuit-breaker. The contactors could be furnished with brake-operating devices and the contactor coils controlled by push-buttons, thus providing emergency stop.

If both sides of the circuit were conducted into the brush carrier H, two sets of brushes and contact pieces would be necessary for this purpose. A cable or cables made up of very fine strands would answer but would not be as neat in appearance as the brushes and contact strips.

The motor that is used to drive a web press for production should be constructed to have speed control by field change sufficient to allow line voltage at the armature brushes at all producing speeds.

The resistance FS at the left end of dial C_1 will be inserted in the field circuit of the large motor after brush D_1 passes from the long strip in dial C_1 causing the motor to increase in speed.

Central Electric Railway Association.

The first bimonthly meeting for the fall of 1908 of the Central Electric Railway Association, of Indiana and Ohio, will be held at Indianapolis, Ind., September 24. Headquarters will be established at the Claypool Hotel. The following papers are announced: "Recent Developments of Lightning Arresters," by David B. Rushmore, engineer, power and mining department, General Electric Company, Schenectady, N. Y.; "The Benefits of the Index Bureau," by Ellis C. Carpenter, general claim adjuster, Indiana Union Traction Company, Anderson, Ind.; "Electric Railway Return Circuit," by E. G. Hindert, chief engineer of power, Cleveland, Southwestern & Columbus Railway, Elyria, Ohio. A paper will also be read by G. H. Kelsay, superintendent of power, Indiana Union Traction Company, Anderson, Ind.

Entertainment will be furnished by the Glee Club of the Indiana Union Traction Company.

THE TEST-METER METHOD OF TESTING SERVICE METERS—V.

(Concluded.)

BY JOSEPH B. BAKER.

A COMMERCIAL TEST METER OF THE "PORTABLE STANDARD" TYPE: THE WESTINGHOUSE PORTABLE STANDARD INTEGRATING WATTMETER.

In general appearance the Westinghouse portable standard integrating wattmeter (Figs. 16 and 17) is not unlike the other forms of commercial test meter that have been described. In the preceding articles it is contained in a polished-wood carrying case with strap and removable cover; it has a large dial, readable from a distance, and a plug switch for changing its capacity to adapt it to the testing of various capacities of service meters; it is started and stopped electrically, so that the use of a stop watch is eliminated; and the testing procedure with it is substantially the same. In fact, except for certain details of construction, to be described, the general description of commercial test meters of the Mowbray type, above, applies (roughly speaking) to this make of test meter.

The theory of its design, however, is entirely different in that this test meter is essentially a *portable standard* meter of adjustable capacity, *i. e.*, an instrument that may be transformed into a test meter of full-load capacity equal to that of the service meter under test, and is not a test meter having a "composite field" winding for giving it a high torque on light load as well as full load of the meter under test.

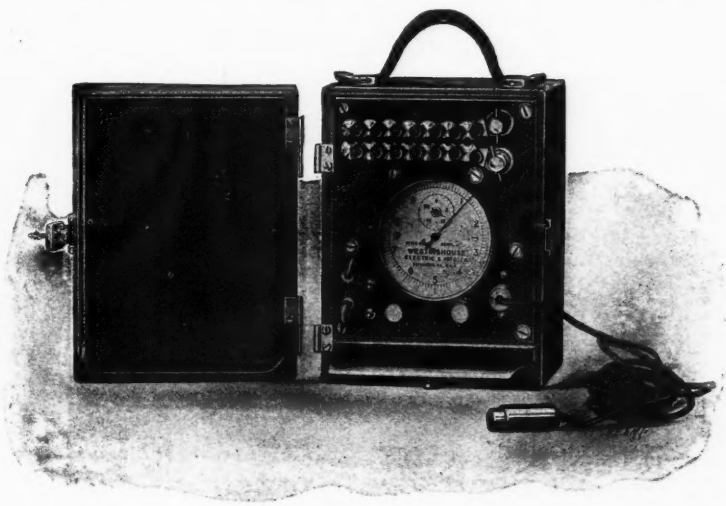


FIG. 16.—WESTINGHOUSE PORTABLE STANDARD INTEGRATING WATTMETER.

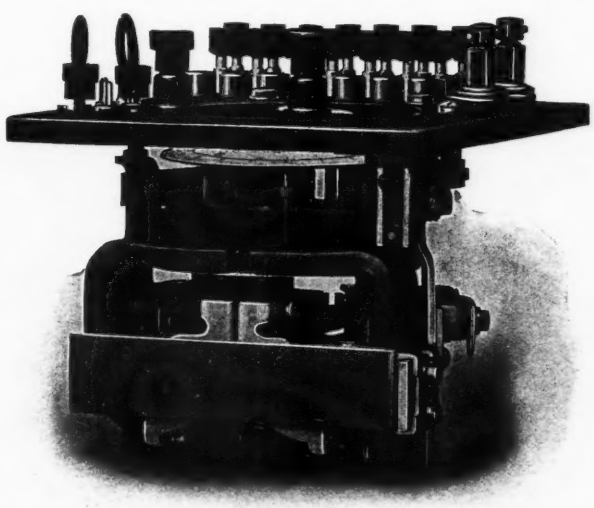


FIG. 17.—INTERIOR VIEW OF WESTINGHOUSE PORTABLE STANDARD INTEGRATING WATTMETER.

In this respect the Westinghouse test meter returns to the original practice of using a portable standard for testing service meters, with the important difference that a single instrument suffices to test service meters of widely varying capacities. Installed meters may run in something like the following distribution in a given central station system: fifty per cent in meters of five-ampere capacity and under; twenty-five per cent in ten-ampere meters, and twenty-five per cent scattering among twenty-ampere, forty-ampere and eighty-ampere capacities.

It is of advantage to have the rotating standard synchronous with the meter under test to save time and risk of personal error. With a test meter having high accuracy on light load (such as is claimed for the Westinghouse induction meters by reason of the ball jewel and light rotating element) this advantage can be attained. Another advantage is that for testing a given service meter the test meter may be connected up to constitute a meter of same capacity as the service meter, which insures comparing the service meter and test meter (which, it may be remarked in passing, should be of the same make), at the same points on their characteristic curve.

The simplicity in testing attained by the use of a test meter synchronous with the service meter under test may be illustrated by the following example: If the service meter (of Westinghouse type, making twenty-five revolutions per minute at full load) makes ten revolutions in a given time, while the test meter makes 10.5 revolutions, the ratio would be 95 +, showing that the service meter is 5 — per cent slow. When the service meter has a different full-load speed than the test meter, an appropriate multiplier must be used. Every Westinghouse portable standard integrating wattmeter is provided with a table to facilitate the testing of service meters in which the full-load speed is other than the standard speed of twenty-five revolutions per minute for Westinghouse meters.

Conditions may arise such that a meter, though accurately calibrated, will be in error several per cent. Then assume that in a certain meter the load error at forty per cent of full load is + 1.0 per cent; that an increase of frequency of ten per cent above normal (from sixty to sixty-six cycles) results in an error of + 1.0 per cent, and that ten per cent lowering of voltage from normal results in an error of + 1.0 per cent. The result is from these coincidal service conditions a total error of + 3.0 per cent in the meter.

The Westinghouse portable standard integrating wattmeter (see Figs. 16 and 17), manufactured by the Westinghouse Electric and Manufacturing Company, is

designed for testing 100 and 200-volt alternating-current meters of a wide range of capacity by operating at normal load on five, ten, twenty and forty amperes (full-load speed with 500, 1,000, 2,000, 4,000 and 8,000 watts) by the use of a composite current coil or series field. This wide range means that the portable standard can test, with equal accuracy, a three-ampere, 100-volt or 200-volt meter on light load, and a sixty-ampere, 100-volt or 200-volt meter on full load. It is made available for testing service meters of other capacities by the use of a Westinghouse portable meter transformer, with the secondary connected to the five-ampere current winding. The main pointer revolves twenty-five times per minute under full load and the full-load torque is eight to nine centimetre-grammes. The meter proper, minus the register, is identical with the standard Type B Westinghouse alternating-current service meter, and the calibrating adjustments are therefore the same as in that meter.

A general view of this test meter, standing on one end with its casing removed, is given in Fig. 17. The test meter is operated, however, in a horizontal position (test-meter shaft vertical) like other makes. It is contained in a seven-and-one-half by eight by nine-and-one-half-inch carrying case. The register differs markedly from those of other makes of test meter, as it contains only two dials, having a ratio of 25 to 1 instead of 10 to 1. The main dial, of a good size relatively to the size of the test-meter top, is divided into hundredths and swept by a pointer fixed on the end of the shaft, as usual; but the smaller dial, placed within the main dial, has a pointer which makes one complete revolution for every twenty-five revolutions of the main pointer. The shunt field is subdivided into two windings, which may be connected in series when the test meter is in use on 200-volt circuits, and in parallel for 100-volt circuits, by changing the position of receptacles attached to short cords —in the lower left-hand corner of the top plate, in the position of the test meter in Fig. 16. Instead of a "pendent" snap switch, for starting and stopping the test meter by closing and opening the potential circuit, a push button is employed.

The employment of a push button instead of a switch has the apparent advantages that it is easier with the former to "coax" the main pointer of the test meter into any desired position for beginning a test, and simpler to start and stop the test, by pressing and releasing the button with the thumb.

The push button is connected at the end of a long flexible cord, having a plug at the other end for insertion in a receptacle in the top plate of the test meter (in the lower right-hand corner in the view) to which the potential circuit of the latter is wired. A compartment is provided in the end of the case for stowing away the cord and push button when the test meter is not in use.

Below the register dials and at the left of the push-button plug is a pair of binding posts for the potential connection to the service mains. On the other side of the dials is a plug switch for making the appropriate connections of the "current coils" of the test meter, for obtaining a full load through the latter in testing service meters of various capacities. This test meter contains a single series field winding, made up of a number of sections which may be connected in series-parallel groups of different capacities by means of the plug switch.

The step-bearing of the Westinghouse portable standard integrating wattmeter is of the well-known ball-jewel type, with a one-sixteenth-inch polished-steel ball between a pair of cup-sapphire jewels. On account of the small mass and short-up-and-down "play" of the rotating element, it is considered unnecessary to provide any "lacking device" for this test meter.

As indicated in Fig. 17, the test meter is really double in construction, having two complete magnetic systems, each comprising a shunt and a series field, at right angles to each other.

Cable-Hauling on the New Manhattan Bridge.

The four huge cables that will support the new Manhattan Bridge, connecting the boroughs of Brooklyn and Manhattan, are now being hauled into place. Each cable will contain thirty-seven strands of 256 wires each, a total of 9,472 wires in each cable, which must be strung wire by wire. The enormous amount of work involved will be done by machinery driven by Crocker-Wheeler electric motors.

The stringing of the wires in each cable is accomplished by means of two traveling sheaves carried on opposite legs of an endless steel rope. Each sheave consists of a three-foot grooved wheel fastened to the hauling rope by means of wrought-iron brackets. The hauling rope is three-quarters-inch in diameter and runs above the position of the bridge cables on heavy rollers supported on uprights on the temporary footbridge. There are five of these hauling-rope supports on the centre span, two on each end span and one on each tower.

The hauling sheaves move back and forth across the bridge from anchorage to

THE HAULING SHEAVE IS ATTACHED BY WROUGHT-IRON LEGS TO A THREE-QUARTERS-INCH TRAVELING CABLE.

anchorage, a distance of 3,223 feet. They are attached one to each leg of the hauling rope so that they move in opposite directions, one crossing the bridge as the other returns.

The wire is delivered to the bridge on enormous reels or spools, weighing three

CABLE-HAULING ON THE NEW MANHATTAN BRIDGE. A VIEW FROM THE TOP OF THE ANCHORAGE.

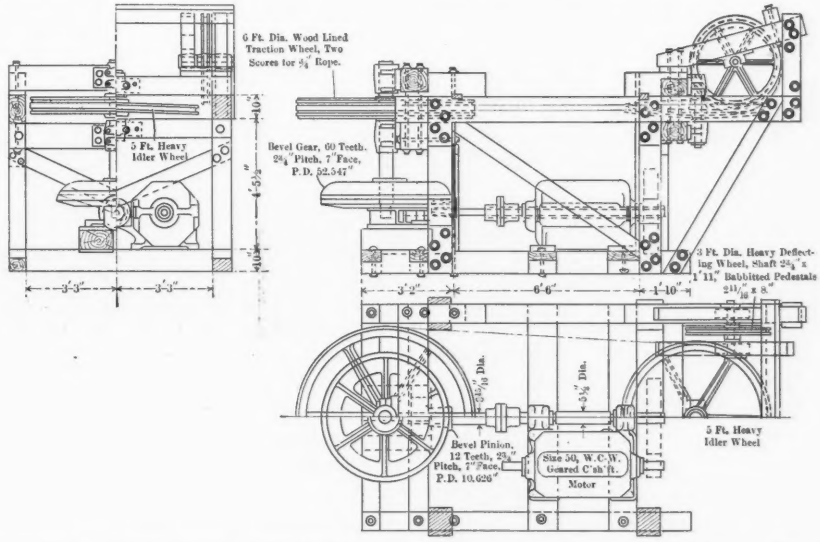
tons each. Half of these reels are placed at each end of the bridge. The end of the wire from a reel at each end of the bridge is put over the hauling sheave at that end and fastened to the anchorage. The machinery is then started and the sheaves move across the bridge, unwinding one wire from each reel. Two wires are thus strung by each sheave every time it crosses the bridge. When the sheave reaches the opposite side of the bridge the bight of the wire is taken off and made

fast to that anchorage, and a new wire hauled from that side on the return trip.

The wires are laid in temporary saddles of four grooved pulleys at each anchorage. As the hauling of each strand of 256 wires is completed the wires are bound together at intervals, and the strand is lifted from the temporary saddle by means of a chain hoist and laid in its proper place in the permanent saddle. Two strands of each cable are wound simultaneously by the two sheaves of each hauling rope.

MILL-TYPE MOTORS DRIVING THE CABLE-HAULING WHEELS THROUGH PINION AND BEVEL GEAR, AND CONTROLLING GEAR, ON THE NEW MANHATTAN BRIDGE.

CABLE HAULING ON THE NEW MANHATTAN BRIDGE BEHIND THE MASONRY CREST ON THE BROOKLYN SIDE. THE EYE BARS ARE A PART OF THE PERMANENT ANCHORAGE.


6 Ft. Dia. Wood Lined Traction Wheel, Two Scores for ¾" Rope.
5 Ft. Heavy Idler Wheel
Bevel Gear, 60 Teeth. 28¾" Pitch, 7" Face, P.D. 52.547"
3 Ft. Dia. Heavy Deflecting Wheel, Shaft 2⅝" x 1'11," Babbitted Pedestals 21/16" x 8"
5 Ft. Heavy Idler Wheel
Bevel Pinion, 12 Teeth, 23¾" Pitch, 7" Face, P.D. 10.626"
Size 50, W.C.W. Geared C'sh'ft. Motor

HAULING-ROPE OPERATING MACHINERY, CABLE CONSTRUCTION PLANT, NEW MANHATTAN BRIDGE.

There is a separate hauling mechanism for each of the four bridge cables, so that they are strung independently of each other. Delays are therefore not cumulative. The delays in one cable affect that cable alone, and the work proceeds on the others. This results in a very considerable saving of time.

Each hauling rope is driven by a fifty-horse-power, 220-volt, Crocker-Wheeler, Form W motor. This is the type of motor designed by the Crocker-Wheeler Company, of Ampere, N. J., for rolling-mill duty, and is well adapted to work of this kind, where sudden overloads and frequent starting and stopping are likely. The motors are fully enclosed and capable of withstanding all kinds of weather and rough handling. The driving mechanism is shown in the illustration. Each motor is geared to a countershaft at a ratio of 5 to 1, and the countershaft is bevel-geared to the driving shaft at a 5 to 1 ratio. On the driving shaft, above the gears, is a wood-lined, grooved, six-foot traction wheel, which drives the hauling rope. A five-foot idler wheel is also provided, so that the hauling rope passes the traction wheel twice to produce the necessary grip.

The hauling rope moves at a speed of approximately 480 feet per minute. It carries the sheaves across the river in about seven or eight minutes. Allowing for the time used in attaching wires at each end, about three trips are made per hour. It is estimated that at this rate the work of hauling will occupy four months, some time being consumed in fixing guide wires for each strand and in adjusting the wires after they are hauled.

The driving motors are all located on the anchorage at the Brooklyn end of the bridge. The reels of wire, as already stated, are stored at both ends of the bridge. The wire was delivered by John A. Roebling's Sons Company, the same people who delivered the wire for the old Brooklyn Bridge thirty years ago. The work of building the cables is being carried on by the Glyndon Contracting Company, of 2 Rector street, New York city.

The hauling equipment for this bridge differs from any previous attempt. It will be remembered that in hauling the cables for the Williamsburg Bridge two steam engines were used, connected to the same driving shaft. It later became necessary to cut this shaft and use the engines independently to avoid accumulation of delays. Even with that arrangement only two cables could be hauled simultaneously. The Glyndon company's plant has double the capacity, besides being electrically instead of steam driven, with the consequent ease of manipulation and control.

CORROSION OF IRON FROM THE ELECTROCHEMICAL STANDPOINT.[1]—II.

(Concluded.)

BY C. F. BURGESS.

ADDITIONAL EXPERIMENTS SHOWING CORRODIBILITY OF STRAINED IRON.

As bearing upon the question whether strained iron has a greater tendency to corrode than the unstrained metal, the following experimental observations may be of interest. These are abstracted from a compilation of results recently obtained by John Thickens, in the applied electrochemistry laboratory of the University of Wisconsin, and also from work carried on under a grant from the Carnegie Institution.

Test rods of mild steel were treated as follows: The rods, eight inches long and three-quarters inch in diameter, were turned down at the middle section for a length of three-eighths inch to a diameter of one-half inch. These were subjected to a stress in a testing machine until the elastic limit had been exceeded and the narrow portion had necked down to a diameter of about 0.4 inch. The entire bars were then turned down to uniform diameter, this being done under running cold water to prevent heating. Bars three inches long were cut from the central portion of the longer bars, and including the strained portion. Some of these bars were subjected to corrosion by suspension in dilute hydrochloric acid solutions, and others by making them the anode in neutral solutions of ammonium chloride and causing current to flow under low current density. In all cases a marked difference was noted in the rate at which the strained portions corroded as compared with the unstrained, and although the sample looked absolutely uniform before corrosion the decrease in diameter of the strained portion after corrosion is marked.

Differences of potential of from five to nine millivolts were noted between two electrodes, one of which constituted the strained portion and one the unstrained.

Another set of samples were strained beyond the elastic limit by torsion. The original bars were three inches by one inch by one inch; they were turned down for a length of one inch at the centre to a diameter of five-eighths inch, the ends being left square. They were subjected to a torsion through 180 degrees, after which the entire length was turned down to a uniform diameter, the specimen in this condition having a uniform appearance on the entire surface. Three grades of iron were employed and are designated by the terms wrought iron, mild steel and electrolytic iron. The last one was prepared from electrolytic iron which had been melted and forged.

These were subjected to corrosion by suspension in dilute acids, as well as by making them the anode in neutral solutions and corroding electrolytically, using a low current density. In all cases a greater corrodibility of the strained metal was noted, as shown by the reduction in diameter, as well as by the general appearance of the corroded surfaces. The greatest difference was noted in the mild steel; it was less marked in the wrought iron and least with the electrolytic iron.

The more rapid electrolytic corrosion of the strained portion appears to be due to the fact that the strained metal is electropositive to the unstrained, the current finding the easier path through the surface of the electropositive metal. Another phenomenon which points to the fact that the strained metal is the more electropositive is noted in immersing the machined test samples in dilute hydrochloric acid. There is a liberation of hydrogen bubbles on the unstrained portion. This is not a temporary condition, but it persists, and indicates that there is electrolytic action, the strained portion serving as the anode and the unstrained as the cathode. It was noted that the purer the iron the less pronounced are the phenomena, and in the case of the electrolytic iron the corrosion as well as the distribution of the evolved hydrogen bubbles were nearly uniform.

The effect of annealing a previously strained bar was noted by heating a machined bar embedded in iron filings to a temperature of 900 degrees Fahrenheit for five hours. The difference in corrodibility between the strained and unstrained portions was then shown to have been completely eliminated by this treatment. In the dilute acid solutions the distribution of the hydrogen bubbles was uniform.

An instance where the increased corrodibility of steel is a matter of practical importance is in the use of punched metal. It is a universal specification in boiler construction that the rivet holes shall be drilled and not made by the cheaper method of punching. The reason for this is that the former method gives better results as far as durability and freedom from corrosion are concerned. In addition to the liability of cracking or otherwise mechanically damaging the metal surrounding the punched hole, it has been found that rivets inserted in punched holes tend to become loose and leaky.

In the process of punching, straining both by compression and tension is produced, the punched disc being compressed and the walls of the hole and the disc having been subjected to tension or shearing. According to those who hold that unstrained metal is more subject to corrosion than the strained, the corrosion around a punched rivet hole will proceed some distance away from the hole; on the other hand, if it is true that the strained portion is electropositive to the unstrained, then the metal nearest the hole should corrode the more rapidly. This is a matter which is capable of settlement by experimental demonstration, and the following experiments were carried out with this object in view:

Some steel plates three-quarters inch thick were punched cold, the punchings having a diameter of one inch. The punched plates were subjected to corrosion, both electrolytic and by dilute acids. It was noted that the corrosion was most rapid on the sides of the hole and in the immediate vicinity.

Some of the punchings were attached to wires and suspended in various corroding solutions. The suspension wires and the point of contact with the iron pieces were protected from the solution by paraffine. It was shown that the sides of the cylinders had a far greater rate of corrosion than had the circular surfaces.

One of the punchings, and a piece of similar size cut from the original steel plate, were suspended as electrodes in a one-quarter normal HCl solution and connected to a mil-ammeter. The current was constant at about one-half mil-ampere for several days, the punching being the anode, and corroding the more rapidly. Similar results were obtained by immersing in a normal KCl solution, the current remaining constant at 0.75 mil-ampere. In both solutions it was noted that on first immersion the current was much higher than the constant value subsequently maintained, this decrease being due to polarization as manifested by an accumulation of hydrogen on the unstrained cathode.

Upon momentarily lifting the two electrodes into contact with the air, and again immersing, the flow of current greatly increased. By blowing air through the solution a similar result was attained, and by adding a very small quantity of sodium

[1] From the presidential address before the American Electrochemical Society, Albany, N. Y., April 30.

peroxide the current quickly rose from 0.75 mil-ampere to over thirty mil-amperes. The effect of oxygen in all of these cases was apparently due to its depolarizing action on the cathode, which allowed more current to flow, and which consequently increased the corrosion of the strained-metal anode. This appears to be in confirmation of the important discovery made by W. H. Walker that oxygen causes oxidation, not by uniting with the iron, but by depolarizing, and allowing other corrosive agents to become active.

The experiments which have just been described are qualitative rather than quantitative, but show in an apparently conclusive manner that strained metal does have a greater solution tension than the unstrained. The results are of technical as well as of scientific interest, and the effects are so pronounced that it appears obvious that our available methods of measuring the differences of potential between strained and unstrained iron when properly applied should yield accurate quantitative data. Further quantitative measurements appear to be desired.

INFLUENCE OF INEQUALITIES OF TEMPERATURE UPON THE CORROSION OF IRON.

As bearing upon the influence of temperature upon the corrodibility of iron, there are presented here the results of some work carried on by S. G. Engle and the writer. These results are more fully described in a thesis by S. G. Engle entitled "The Influence of Inequalities of Temperature Upon the Corrosion of Iron." This investigation was originally taken up in connection with the study of certain peculiar corrosion phenomena which are commonly found in locomotive boilers.

To one familiar with the corrosion produced by stray currents in underground pipes, the pitting and grooving of boiler tubes have the appearance of being electrolytic action. A place where corrosion is particularly noticeable in locomotive boilers is just inside the end shells where the tube is expanded. At one end of the boiler a copper shim is placed between the tube and the end plate, the purpose being to utilize the ductility of the copper in making a tight joint. At the other end the tube is expanded directly to fill the hole in the end plate. If copper shims were used at both ends of the tubes a logical explanation of the fact that tubes corrode in the immediate neighborhood would be that a voltaic couple is set up between the copper and the iron. It appears, however, that the corrosion is just as marked at the end where copper is not used, and other explanation must, therefore, prevail. The one most commonly accepted is that the iron tube on being expanded is thereby strained and this strained metal corrodes more rapidly than does the neighboring unstrained metal. There is not enough data to absolutely fix this point.

There is also an irregular pitting in the tubes, the rapidity of the action depending upon the care taken of the boiler, upon the kind of feed water used and perhaps upon other factors. Among the results of this kind of corrosion are the frequent puncture of the tubes, the extinguishing of the fire, the stalling of trains between stations, and the retirement from commission of valuable machinery. The pitting may be somewhat general in distribution, but usually there are a few deep pits with the surrounding metal apparently intact. It is a matter of general observation that the pitting is more marked on the tubes nearer the shell of the boiler, rather than on those farther toward the interior—in fact, the interior tubes may last as long as several sets of tubes renewed on the lower row. This is explained commonly by the supposition that the circulation of water, also the introduction of fresh feed water, are such as to emphasize corrosive action.

The object of the investigation previously referred to was to determine if possible whether the equivalent of galvanic cells is established in locomotive boilers, due to inequalities of temperature in the different portions. The most highly heated metal in the boiler is the tubes which are exposed to the hottest products of combustion. The lower tiers of heated tubes are probably subjected to this heat. The direction of the flow of heat is from the interior of these tubes to the water, which in turn is in contact with the cooler shell of the boiler. If the boiler tube is, by being hotter, rendered more electropositive than the boiler shell, we would expect a galvanic action resulting in the corrosion of the tube. We would expect the corrosion to be at such places as the current finds the most ready path between the anode and the cathode. The shortest path between the hot anode and the cooler cathode would be between the lower and the side tubes, and the interior of the boiler shell.

An interesting peculiarity in the electrical heating is shown in the decrease of potential which is first produced by the heating and the subsequent rise after the minimum point has been reached. This minimum was not observed in the test where the external heat was applied.

It was desired to carry the temperatures of the iron surface beyond that which was possible by the former methods of heating, and this was accomplished by bending a soft iron wire into a "U" shape, immersing it in the water and heating it by the passage of an alternating current through it. Voltage readings were taken between this electrode and another one of the same material which was not heated by the passage of the current. It was found that there were certain irregularities in the measurements, due to the fact that the wire dipped down through the surface of the electrolyte. This was remedied by passing the wires out through the bottom of the vessel which contained an asbestos stopper. Water taken from the locomotive boiler was again used as the electrolyte. It was found that the heated wire first became more electropositive, then became steadily negative as the heating progressed, until the wire became fused. This tendency for the heated wire to become negative in this case is ascribed to the fact that the wire became hot enough to oxidize when in contact with the water, coating itself with the more electronegative iron oxide.

The experiments thus far indicate decided tendency for a heated surface to become electropositive, as compared with the cooler piece of metal in the same solution. This is a condition which may exist in locomotive and other boilers, although direct conclusions could not be drawn from these experiments without recognizing the fact that these were carried out under atmospheric conditions, while the water in a boiler is usually under high pressure.

If conclusions might be drawn from these data they would be to the effect that the presence of oxygen has a greater influence than has the presence of carbon dioxide in promoting the corrosive action. To compare the corrosive action in the solution as used in the last test to the same solution freed from carbon dioxide, this gas was expelled. Run was made on this same solution by applying heat and raising the pressure to a hundred pounds. This showed apparently that the carbon dioxide has practically no influence on the corrosion current.

The effects of the addition of various other dissolved substances were observed; thus treating lake water with one gramme of soda ash per five gallons of water, a method commonly employed for treating boiler-feed water, gave potentials in the

opposite direction, the heated tube being the cathode. This same result was found in a more pronounced way by increasing the percentage of soda ash. However, with a solution obtained from a locomotive boiler which had been treated with soda ash and in which the soda ash had been concentrated by repeated evaporation, the inner tube became the anode. The heated tube was likewise found to be the anode when using one gramme of magnesium sulphate or magnesium chloride per gallon.

It was always noted that no matter what electrolyte was used, the current gradually increased to a certain point and then decreased. It was also noted that in repeating tests without otherwise changing the solution, the successive results always gave lower values of current and pressures. In other words, a fresh solution always causes apparently a higher current and more corrosion than one which has been used. This would coincide with the general belief that it is the fresh feed water in boilers which has the greatest corrosive action. This fact, and the one that each curve shows the current to reach a maximum, after which it decreases, even if the heat be kept constant, require an explanation. Among the suggested explanations is the influence of the formation of a high resistance coating on either the anode or the cathode, formed from corrosion products, and a second factor might be the partial decomposition of the electrolyte or a decrease of such materials in the electrolyte as might promote corrosion. For example—the presence of oxygen acts as a depolarizer at the cathode, and facilitates the flow of current as long as there is any oxygen present. It is natural to expect, therefore, that as the oxygen in the boiler water is eliminated, either by escaping with the steam or uniting chemically with other materials, the polarization will increase, and consequently the measured voltage and current will decrease.

That both of these factors apply in part should undoubtedly be recognized. From the testing apparatus the tube was removed at frequent intervals and in all cases a coating of more or less adherent scum or incipient scale was observed. Upon removing this and again making the test an increased current was noted. An examination of the surface of the tube after various runs revealed the fact that the corrosion had not been uniform but was in the form of pits which could be readily distinguished by the naked eye.

W. H. Walker has given us his opinion that the presence of oxygen in a solution promotes corrosion by acting as a depolarizer and in this way allows a more ready passage of galvanic or corroding currents. His views can undoubtedly find confirmation in the study of boiler corrosion, for it has been repeatedly noted that water which has been thoroughly saturated with air and consequently with oxygen, is especially corrosive when used as feed water. In fact, some of the most injurious cases of corrosion can be found where distilled water is used, distilled water having been allowed to become saturated with oxygen from the air.

The question naturally arises, "Do the currents, as measured in the tests referred to, reach a sufficiently large value to indicate a serious amount of corrosion?" Various of the laboratory tests have shown current of 0.01 ampere. In twenty-four hours this is equivalent to a corrosion of one-quarter gramme of metal; and since this corrosion is not evenly distributed but is confined to a few localities, it is obvious that these laboratory experiments will give basis for the belief that pitting of locomotive boiler tubes is galvanic action, and that the galvanic action is sufficiently rapid to cause perforation of the tube in a few months, or weeks, or even days.

Chicago Telephone Company to Distribute Stock Dividend.

Announcement is made that the directors of the Chicago Telephone Company have decided to distribute a stock dividend of $4,500,000 among the shareholders, the amount to be deducted from the corporation's surplus and reserve accounts of $7,332,038. It has, as well, provided for the authorization of $15,000,000 five per cent first mortgage bonds, which are to be issued in the future for construction and extension purposes. The new stock will be issued October 10, in the ratio of one share of new stock for each five shares of present holdings.

In view of the stock dividend, which will increase the company's capitalization to $27,000,000, the next quarterly dividend, payable December 31, 1908, will be two per cent, instead of two and one-half per cent, as heretofore, and it is proposed to maintain the rate of eight per cent per annum thereafter. It has been decided to finance the company's construction wants for the time being through the sale of first mortgage five per cent bonds. The proposed mortgage of $15,000,000 will be on the property as it stands at this time.

LIGHTNING PROTECTION.[1]

BY E. E. F. CREIGHTON.

During the past three years—in fact, during the past five years—very extensive measurements, starting first in the laboratory and then finally carrying the methods to the line, have been made on the conditions of lightning existing on power circuits. During last summer the entire time was spent at the plant of the Animas Power and Water Company, in Colorado, where they have vicious storms practically every day during the season. The frequency of cloud lightning was measured, and was found to be in the neighborhood of about one million cycles per second. The frequency of the discharge from an idle line was also taken and found to be about 3,000 cycles.

Next, current was not measured but was indirectly calculated from other tests, and it was possible to predetermine just how many amperes of lightning current would flow for every volt on the line. Another interesting point was, What was the voltage induced on the line? We have made no tests on direct strokes of lightning, because it is so very difficult to get them; they occur infrequently, and when they do occur it is best to be out of the way. So the only tests we made were on the induced strokes, and we found potentials momentarily on the line as high as several hundred thousand volts—between 300,000 and 500,000 volts.

The next thing we measured was the quantity of electricity that was in the stroke. That, of course, varies with every cloud and with the relative position of the cloud and the line. The last thing we measured was the duration, and that is a most important thing to know. The ordinary lightning stroke will have a duration of about one one-hundredth of a second; but the trouble is not in the actual duration of the stroke, but in its recurrence. We found numerous cases where a stroke of lightning would come from the clouds and within a second there would be seven successive strokes which would extend over a complete circuit. That is the cause of some of the failures of the multi-gap arrester.

There are a great many causes of the high-potential surges on the line; most of these can be considered due to conditions. The first is the direct stroke of lightning. In the cities a direct stroke of lightning very seldom hits a line; it hits a tree or a building somewhere near, and

[1] Abstract of an address before the Ohio Electric Light Association, Put-in-Bay, Lake Erie, July 27.

there is an induced stroke on the line. Therefore there is no protection for direct strokes of lightning for this reason, that the lightning goes to ground within a very short distance, say within seven poles from where it strikes, and there is not one chance in a thousand that a lightning arrester would be situated at that point.

Then the next question is, whether the lightning arrester would take care of the discharge if it were at that point. It would not be economy to design a lightning arrester to do that, because one could not afford to pay for it. It would be so expensive that it would cost as much or more than the apparatus that it was protecting. The only protection that can be given against a direct stroke is to install an overhead ground wire and ground it frequently. Now that is quite unnecessary in the cities, because the same kind of protection exists in the telephone wires if they run above the power lines, and in the trees and buildings that often overhang the line.

The second kind of a lightning stroke is the induced lightning stroke which comes from the cloud being over the line and inducing a static charge on the line, and discharging at some point near the line. That is a problem that is quite easy to take care of and which is pretty well taken care of at the present time by the multi-gap arrester. The multi-gap arrester in its latest improvement has two or three paths to ground so that it can take care of lightning of a different quantity of electricity—different intensity. The only thing that this multi-gap arrester can not take care of is the multiple strokes just mentioned. Occasionally it will be found that the multi-gap arrester blows up and goes to pieces when lightning is induced on the line, and in most of the cases it has been found that this is due, not to the inefficiency of the arrester, but to the local condition of the circuit.

The third condition on the line, and it is the most important and the hardest one to take care of, will be due to an accidentally grounded phase; for example, the breaking of an insulator so that the arc can play from the line to the pin, or from the line to a green branch, or from the line over to the bushing of the transformer which is grounded. These are the three conditions usually met which are hardest to take care of. Every time that the arc jumps from the line to the insulator—and it does it every half cycle as a rule—there is a surge set upon the other phases of the system which will tend to make it discharge through the internal windings or bushing or insulator elsewhere. In so doing it will cause a short-circuit; of course, an interrupted circuit. It is far better to interrupt it than to let it play, because of the damage which may occur internally in the transformer. In this case if there is a multi-gap arrester on the circuit and it is designed to take care of the discharge, it will discharge during the first break of the current, which is the half cycle of the discharge. It puts out the arc at the end of the half cycle, but again the potential goes in the opposite direction and starts the arc again, the surge is re-established on the circuit again and the multi-gap arrester discharges. Now the multi-gap arrester can not be designed to carry the current continuously at any commercial cost figure; consequently, under those conditions the multi-gap arrester must necessarily be destroyed. The only lightning arrester that can take care of that condition is the newly developed aluminum arrester.

The fourth condition likely to be met with is something that has come up quite recently and that seems to occur on motor circuits; for example, in a large building where a direct current is operating electric motors for elevators and other purposes. If the load in the building becomes so great that a fuse blows, then that circuit is disconnected from the main circuit, with the meter on the inside, and sometimes the motor fields discharge through the meter and raise the potential, and in that way destroy the meter. If there is a heavy current flowing through a motor and the circuit is suddenly broken, it amounts to exactly the same thing as an induction coil, and the voltage depends entirely on how quickly the circuit is broken. If the fuse breaks the circuit very quickly a very high rising potential results. The protection for that is a direct-current type aluminum arrester.

These then are the four kinds of lightning potentials or surges that usually have to be met: First, a direct stroke of lightning; second, an induced stroke from a cloud; third, an accidentally grounded phase, and the fourth is the inductive kick from a motor circuit through such an apparatus as a meter.

Just one word about the aluminum arrester and the principle that it works upon. There are two forms now that are out, one for alternating current and the other for direct current. The alternating-current arrester consists of a series of cells made up from inverted cones, one inside of the other and separated by fibre washers. Between each cone is poured in a certain amount of electrolyte, making it about half full; then the whole mass is immersed in a tank of oil, the oil having two qualities: first, that of insulating the parts that are not in the electrolyte, and, second, cooling off the surface so that the arrester may operate for a long time. The characteristics of the aluminum cell are the same as the characteristics of the arrester, the arrester being made up of multiple cells. With a 300-volt circuit there would be one cell; with any higher voltage than that the total voltage between the line and ground divided by 300 would give the number of cells that would be placed between the line and ground, or the line and neutral, according to the conditions. The characteristic of each cell is very similar to a storage battery on a direct-current system. The aluminum plate surface goes through a chemical process by which a film is formed of very great thinness. It gives the surface a slightly whitish appearance. This film bears much the same relation to the circuit as does the counter electromotive force in a storage battery floating on the line. With a single cell on a 300-volt direct-current circuit the leakage is reduced to a very small volume; the cell is connected directly to the circuit and left on the circuit. The leakage of current will be about 0.001 of an ampere, but for every volt of pressure-rise above 300 the cell will allow current to flow through it equal to the excess voltage divided by the resistance. Since the resistance is very low, about one-quarter ohm, this means about an ampere for every volt, the arrester acting in all respects as a safety valve on the system. At normal pressure there is practically no discharge, but for abnormal pressures the valve opens up (there are myriads of them on the surface of this aluminum plate), allowing the electricity to flow through. In a direct-current cell the ratio of the current between normal potential and double potential is about one million; in other words, the current increases from 0.001 ampere to 1,000 amperes. So far as can be seen in the study of lightning, this is sufficient to take care of any kind of a discharge that may come on a circuit.

In the alternating-current lightning arresters, made for voltages from 2,300 volts to 110,000 volts, a gap is placed in series in order to prevent the wearing of the plates by the constant action of the alternating current. The alternating current wears the plates very much more rapidly

Storage-Battery Regulation of a Sixty-Cycle Alternating Load.

During the recent reconstruction of the Madison avenue power-house of the Elmira Water, Light and Railroad Company, Elmira, N. Y., there was installed a Gould regulating battery system embodying several novel features.

This plant supplies all the electrical power for Elmira and vicinity, which, in addition to the incandescent and arc lighting, consists of direct-current railway, direct-current power, alternating-current power and high-tension alternating-current power to interurban and suburban railway substations. The power is generated at 2,200 volts, three-phase, sixty cycles (with the exception of some of the old equipment held as reserve only), and the problem presented was to regulate the various fluctuating loads so that they could be carried by the generators supplying the lighting circuits without rendering this service unsatisfactory or requiring the operating of additional capacity to carry the momentary peaks.

In order to obtain advantage of the staggering of the peaks on the various fluctuating load circuits, the entire fluctuating load was concentrated on an auxiliary bus, the direct-current load being supplied through rotary converters, and treated so far as the regulation control was concerned as an alternating-current load, as shown on fundamental diagram of connections (Fig. 1).

The battery installed consisted of 280 cells of the Gould Storage Battery Company's type S-615 in type S-623 lead-lined tanks, having a discharge capacity of 560 amperes for one hour (ultimate capacity when the tanks are filled of 880 amperes for one hour), and capable of delivering momentary discharges up to three times the one-hour rate (Fig. 2).

This battery in series with a 140-volt, 600-1,700-ampere booster driven by a 2,200-volt, three-phase, sixty-cycle induction motor, is connected across the direct-current railway buses, the same being supplied from the variable-load alternating-current bus by transformers, and a 750-kilowatt, 600-volt rotary converter. The field of this booster is automatically controlled by an exciter set. The operation of this set is identical with that commonly employed on direct-current regulating systems with the exception that an additional machine is added in order to remove the influence of any changes in the direct-current line voltage, and that the usual regulating field-winding is replaced by a fine-wire winding controlled by a Gould regulating converter. This converter, which is driven by a small synchronous motor (Fig. 3), is fed by a series transformer placed in the totalized variable-load connection, and delivers a direct-current output proportional to the true energy component of the current in the alternating circuit. An auxiliary series transformer with sectional secondary taps brought to a compensator head mounted on the switchboard is connected in the alternating-current leads of the regulating converter, thus providing means for changing the effective ratio of the series transformer and permitting the average load supplied to the variable-load bus to be changed at will. It will be seen that the action of this system corresponds exactly with that of the usual direct-current system, the series transformer, compensator and regulating converter taking the place of the shunts and adjusting switches of the direct-current system. Any increased

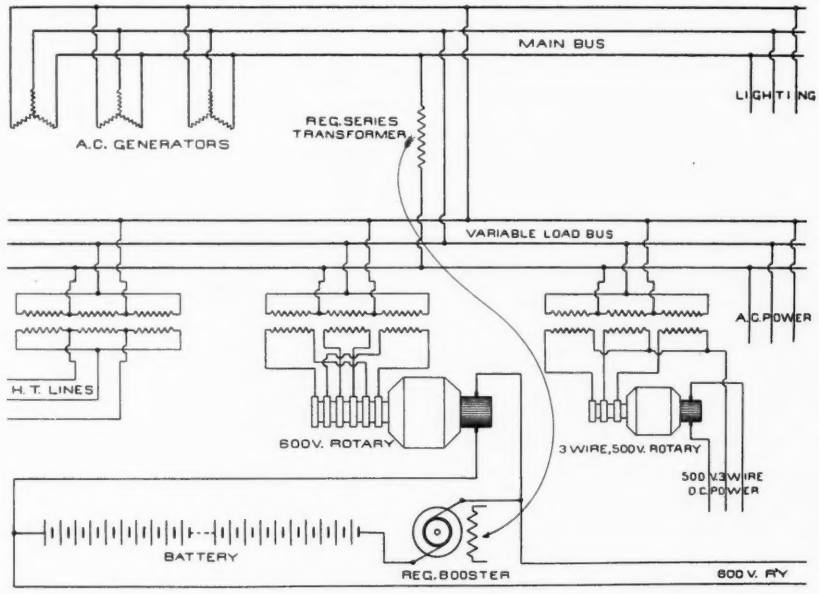


FIG. 1.—DIAGRAM OF FUNDAMENTAL CONNECTIONS, ELMIRA WATER, LIGHT AND RAILROAD COMPANY, ELMIRA, N. Y.

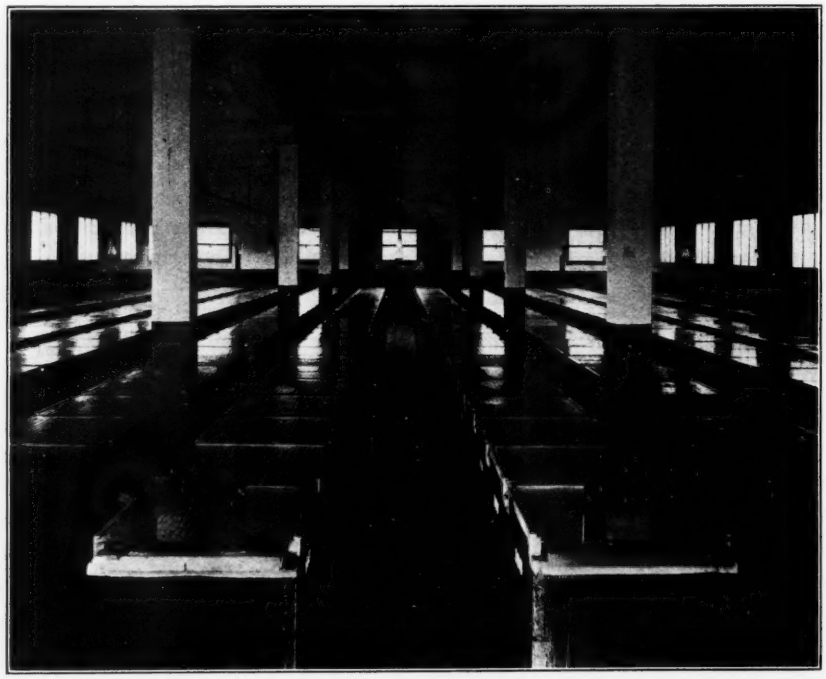


FIG. 2.—BATTERY ROOM OF THE ELMIRA WATER, LIGHT AND RAILROAD COMPANY, ELMIRA, N. Y.

demand for true energy on the variable-load bus causes an increased output from the series transformer in phase with the voltage wave, thus increasing the direct-current output from the regulating converter and causing the battery to discharge, or to charge when the demand on the bus falls below the average for which the adjustable transformer is set.

As long as the demand on the direct-current feeders is greater than the battery discharge, the action of the battery is to relieve the station of a portion of the direct-current load, the battery discharging directly to the direct-current feeders and reducing the load on the rotary. When the load conditions are such that the battery discharge is greater than the direct-current demand on the station, the battery first supplies the entire direct-current load and then inverts the surplus through the rotary and transformers to the 2,200-volt, three-phase bus. The ordinary peaks on the station do not require this actual inversion, the same only taking place at times of heavy peaks on the outgoing alternating-current feeders with a low average load on the variable-load bus, thus giving the alternating regulation with only an exceptional inversion and omitting the losses that would be incurred by a double transformation. The duty required of the rotary is approximately the same as operating without the battery, the peaks being slightly less with the battery in use.

This plant has been in successful operation for several months, the energy supplied to the variable-load bus being held constant within the limits of plus or minus four per cent, thus permitting the variable load to be carried as a steady "lighting" load, and at the same time the connections used eliminate the probability of any of the lighting energy passing through the battery and converting apparatus and thus reducing the effective capacity of the same or increasing the losses by unnecessary storage.

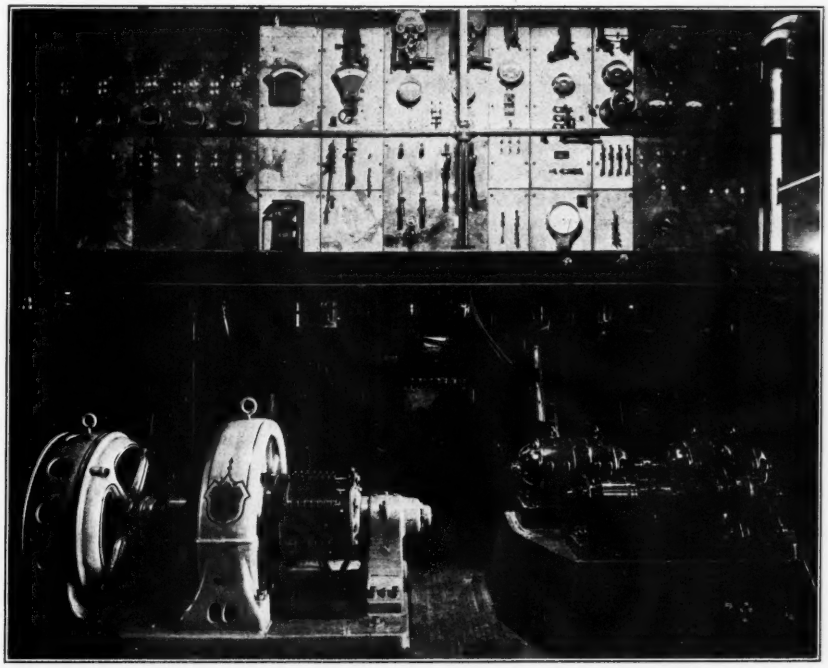


FIG. 3.—REGULATING APPARATUS, ELMIRA WATER, LIGHT AND RAILROAD COMPANY, ELMIRA, N. Y.

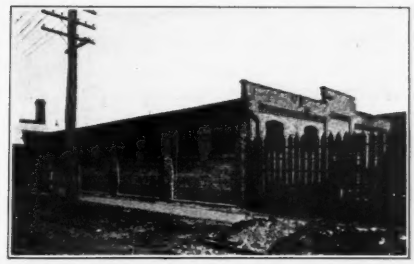


FIG. 4.—BATTERY HOUSE OF THE ELMIRA WATER, LIGHT AND RAILROAD COMPANY, ELMIRA, N. Y.

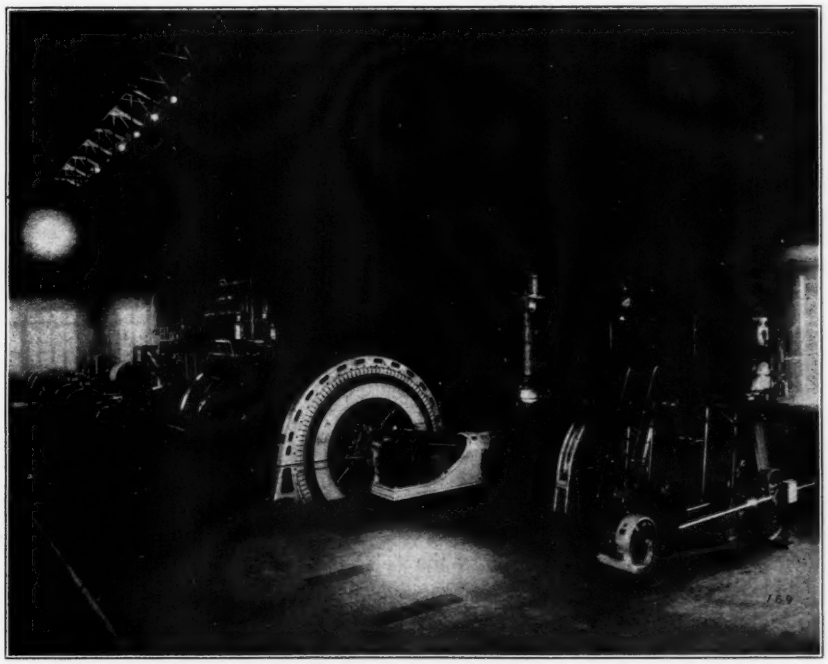


FIG. 5.—INTERIOR OF POWER-HOUSE, ELMIRA WATER, LIGHT AND RAILROAD COMPANY, ELMIRA, N. Y.

Association of Car-Lighting Engineers.

A meeting was held in Chicago, Ill., on August 24 and 25, to form the Association of Car-Lighting Engineers. The date for the first annual meeting was fixed for November 18, in Chicago. Committees were appointed to report on the subjects of illumination, wiring, connectors, lamps, organization, history of electric lighting on steam railroads, axle lighting, straight electric lighting, storage batteries, straight storage-lighted cars, head-end systems and entertainment.

The following officers were elected: President, A. J. Farrelly, Chicago & Northwestern Railway; first vice-president, E. M. Cutting, Southern Pacific; second vice-president, A. J. Collett, Union Pacific; secretary, G. B. Colegrove, of the Illinois Central.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

WESTERN UNION TELEGRAPH COMPANY.

The preliminary estimated statement of the Western Union Telegraph Company for the quarter ended September 30 gives net revenue of $1,700,000; bond interest, $433,062; balance, $1,266,938; dividends, $497,789; surplus, $769,149.

UNITED ELECTRIC SECURITIES COMPANY.

The United Electric Securities Company has issued a statement of earnings for the six months ended July 31, as follows: Bond interest received and accrued, $160,817; interest on notes, bank deposits, etc., $9,435; dividends received, $1,352; total earnings, $171,604; collateral trust bond interest, $99,065; expenses, $16,225; total charges, $115,290; net profit from income, $56,314; profit from sale of securities, less adjustments for discount on collateral trust bonds bought and sold, $17,691; six months' surplus, $74,005; profit and loss surplus, $1,291,677; preferred stock dividend, $35,000; surplus, August 1, $1,256,677.

EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.

The annual report of the Edison Electric Illuminating Company, of Boston, Mass., for the year ended June 30 shows gross of $4,229,239; expenses, $2,690,419; net, $1,538,820; miscellaneous income, $38,442; total income, $1,577,262; interest, etc., $54,989; balance, $1,522,273; miscellaneous charges, $125,368; balance, $1,396,905; dividends, $1,390,796; surplus, $6,109; total surplus, $247,219.

UNITED TRACTION COMPANY.

The United Traction Company, of Albany, N. Y., for the quarter ended June 30 reports gross of $498,245; expenses, $305,027; other income, $29,341; charges, $91,884; surplus, $130,675.

HUDSON VALLEY RAILWAY COMPANY.

The report of the Hudson Valley Railway Company, of Glens Falls, N. Y., for the quarter ended June 30 shows gross of $145,547; expenses, $113,252; other income, $1,149; charges, $55,886; deficit, $22,442.

KEYSTONE TELEPHONE COMPANY.

The report of the Keystone Telephone Company for the year ended June 30 shows gross earnings of $1,051,071; expenses and taxes, $539,123; balance, $511,948; reserve for renewal and interest charges, $413,112; surplus, $98,836; previous surplus, $503,436. The surplus is equal to 5.06 per cent on the $1,936,850 preferred stock.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

The report of the associated Bell Telephone operating companies, not including the long-distance lines of the American Telephone and Telegraph Company, for the month of July and seven months ended July 31, shows a further growth in the company's business. The figures for the month of July are as follows: Telephone revenue, $10,014,300; general operating and maintenance expenses, $7,175,100; net income, $2,839,200; sundry earnings, $453,600; total net earnings, $3,292,800; interest, $627,200; available for dividends, $2,165,600. The figures for the period from January 1 to July 31 are as follows: Telephone revenue, $68,841,700; general operating and maintenance expenses, $50,599,800; net, $18,241,900; sundry earnings, $2,963,000; total net earnings, $21,204,900; interest, $4,529,800; available for dividends, $16,675,100.

LETTERS TO THE EDITOR.

"The Gasolene-Electric Drive for Vehicles."

To the Editor of the Electrical Review:

In your issue of August 29, 1908, page 300, I note an editorial comment on "The Gasolene-Electric Drive for Vehicles."

Some eight or ten years ago a United States Consul's report from, I believe it was Belgium, gave an extended account of an automobile made by a Belgium firm, the essential features of which were a longitudinal shaft direct geared to the rear axle and arranged for direct coupling to a gasolene engine and an electric motor; that is, just ahead of the rear-axle gearing was a friction clutch, next ahead was an electric motor with brushes so arranged for running in either direction, and so wound as to act as a generator when running at excess speed. Ahead of this motor on same shaft was a friction clutch; ahead of this clutch a single-cylinder gasolene engine. The equipment carried a small-capacity storage battery.

The principle of operation was that the pushing of a lever forward connected the storage battery to the electric motor; that when sufficient speed was attained by the machine, automatically the gasolene engine would come into action.

The gasolene engine's normal arrangement was such as to have a speed slightly in excess of the motor, which would cause the motor to charge the storage battery; that is, at a normal running speed under ordinary conditions, the machine was driven by a single-cylinder gasolene engine direct, the excess power of same being taken up through the generator into storage battery. The slower speed was handled entirely by electric motor. In case of long, heavy roads, the rear clutch could be disconnected and generator charged from time to time.

It appeared to me at the time I saw this report that if this principle was developed by a progressive American firm, it would have decided advantages over the then used automobile devices, and I believe could be developed into a better device than is now used.

J. F. Noble.

Oklahoma City, September 2.

Brusio Hydroelectric Plant.

To the Editor of the Electrical Review:

In my article entitled "The Brusio Hydroelectric Plant and Its 50,000-Volt Swiss-Italian Transmission System," published in the Electrical Review for August 8 and August 15, there appeared the following inaccuracies": "There are at present installed six main units and four exciters; two main and two exciter units are of the impulse type, by Escher, Wyss & Company; four main and two exciters are of the Girard type by Picard, Pictet & Company."

The statement should read: "There are at present installed ten main units of 3,500 kilowatts' capacity each, and four exciters of 250 kilowatts' capacity each. Two main units and two exciters are of the Girard type with partial admission, by Picard, Pictet & Company, and eight main units and two exciters are of the impulse type, by Escher, Wyss & Company, Zürich, who also supplied the entire penstock equipment."

It might also be of interest to state that the further equipment of the Brusio plant will be impulse wheels, which proved more efficient. It will be remembered that the plant is operating under a head of 1,300 feet.

Frank Koester.

New York, September 14.

Cost of Subways.

The subway systems now in service in Greater New York have already cost the city the sum of $54,802,944, as shown by a statement prepared by the Public Service Commission to be submitted to the Tax Department. The Manhattan tubes have required over $48,000,000 of this sum, over $3,500,000 has been expended on the Brooklyn extension, and over $3,000,000 has been used in building the Manhattan section of the bridge loop now in course of construction.

PENNSYLVANIA ELECTRIC ASSOCIATION.

FIRST ANNUAL CONVENTION HELD SEPTEMBER 8-9.

The Pennsylvania Electric Association held its first annual convention at Eagles Mere, Pa., on September 8 and 9. There were represented forty companies, including most of the principal electric lighting companies in the state, and at the time the convention was called to order there were about one hundred delegates and guests present.

After the reports of the officers and the address of the president were presented the association discussed the advisability of reorganizing on the basis of a state branch of the National Electric Light Association. The discussion was opened by W. C. L. Eglin, president of the National Electric Light Association, who outlined the scope of the association's work and the amendments made to the constitution and by-laws to allow of the organization of state and territorial branches. The subject was discussed very thoroughly by the various members present and practically all of the features of association work were treated. The unanimous opinion was expressed that there were no disadvantages in a state association immediately becoming a state branch of the National Electric Light Association, and that advantages were to be gained along all of the lines of association work. When, later, the question was voted upon it was unanimously carried that the state association should reorganize as a state branch of the National Electric Light Association, and a committee was appointed to carry out the details. L. H. Conklin, Connellsville, was elected president; E. F. McCabe, Lewiston, vice-president, and E. L. Smith, Towanda, secretary and treasurer.

There were also in attendance at this convention a number of representatives of manufacturing companies and supply dealers, and the state branch of the association has arranged for their attendance at the state conventions.

The programme arranged for embraced most of the questions that are of importance at this time, and all of the subjects were freely discussed.

The various details of the handling of the convention were excellently managed and all of those in attendance appreciated the efforts that had been made in their behalf by the officers and committees.

The opinion was universally expressed that state conventions are beneficial to the companies and fill a field that can not properly be covered in any other way.

The meetings were well attended. The paper on "The Day of Distribution," by T. Commerford Martin, was well received and opened up an interesting line of discussion, particularly on overhead-line distribution, a committee being appointed to prepare specifications and instructions regarding proper construction, and to give particular attention to foreign attachments and railroad crossings. A vote of thanks was extended to Mr. Martin.

F. W. Willcox, of the General Electric Company, Harrison, N. J., presented an interesting paper on incandescent lamps, which opened up a wide discussion on this subject.

Amusements and entertainment were provided for the ladies accompanying the members. One of the enjoyable features in which all took part was a corn roast and camp fire on the shore of the lake. An informal glee club rendered college songs and a generally pleasant evening was spent, the success of which was largely due to the entertainment committee.

THE CONVENTION OF THE PENNSYLVANIA ELECTRIC ASSOCIATION, EAGLES MERE, PA., SEPTEMBER 8 AND 9.

Water Power in France.

The Journal of the Royal Society of Arts contains an interesting report on this subject. According to this the total water power utilized in the Alps is nearly 300,000 horse-power, while the yearly average obtainable is estimated by various experts at between 2,300,000 horse-power and 15,000,000 horse-power. Power is supplied to undertakings of two kinds. The first consists of factories engaged in the electrometallurgical and electrochemical industries, and utilizing water power obtained by them on the spot for the manufacture of aluminum, calcium carbide and ferro-silicon. These at present utilize over 100,000 horse-power in Dauphiné alone. The other kind consists of enormous power stations, pure and simple, for supplying current, not only to various works in the neighborhood, but within an ever-growing area. Lyons is lighted by power from the Volta Works at Moutiers, belonging to the Grenoble Power and Light Company, which transmits 6,000 horse-power over a distance of 112 miles under a pressure of 57,000 volts, while from Lyons to Valence the whole Rhône Valley is fed by power stations situated in the departments of the Savoy and Isère. Even St. Etienne and Roanne, in the department of the Loire, will, before long, be using electricity generated far away on the other side of the Rhône, in the valley of the Drac, a tributary of the Isère. As is well known, proposals have also been made to supply Paris from the Rhône, and schemes have been got out whereby 100,000 horse-power could be thus transmitted. These are, however, merely suggestions so far, but if the present rate of progress be maintained, in a few years the whole of France will be supplied with hydroelectric power from a few distributing centres. The industrial importance of such a development would necessarily be very great.—*Electrician (London)*.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Purchase of Coal on a Scientific Basis.

Several articles have appeared recently, in the main having been criticisms of the English coal industry, and seeming to place this industry in a somewhat unfavorable light. The present article, on the question of buying coal for industrial purposes, is from the coal-seller's point of view. In the first place, the assumption that British coal merchants are averse to modern methods of coal selection is considerably wide of the mark. The rule which must apply to all contract work in engineering—that the vendor must know as much about the article on sale as the buyer—holds good in coal dealing. A coal factor is very often in the position of actually having to advise a buyer as to the quality of coal to be selected, having regard not merely to the intrinsic quality of the fuel, but also in relation to furnaces or other purposes for which it is to be used. For this reason, if for no other, every British coal factor who takes his position seriously welcomes any scientific test which will help him to predetermine the performance of the coal for which it is his duty to find a market. The rock upon which the discussion appears to split is the undue prominence given to calorific value pure and simple. The chemical test of fuel is a very useful step to take, and the results of analyses should be carefully studied in selecting coal. It must be remembered, however, that what is ultimately aimed at is working performance, of which the only conclusive test is the trial of a sample ton, under ordinary working conditions, by a skilled fireman free from bias. It is pointed out that in a certain test of two samples of steam coal, the calorific value of one sample, as judged by the pounds of water raised to steam, was 13.76 pounds, while that of the latter was 13.7 pounds, both at a temperature of 212 degrees Fahrenheit. When, however, these two classes of coal were tried under working conditions, the second sample turned out, in a particular case, so much superior in result to the first that it was unhesitatingly adopted and retained. This might be explained by the difference in nature of the two coals and the particular requirements of the furnaces in which they were used. To require that all the coal should come from the same seam of a colliery is unreasonable. If a colliery is working one seam only, it is quite reasonable to stipulate that coal alone from that seam is secured. If, however, it is getting its output from two or three seams at different levels, it is nearly always found that the coal from these seams is mixed at the pit mouth, and the various qualities sent out are products of various seams.—*Abstracted from the Electrical Review (London), August* 28.

Telegraphy and Telephony Over Electric Light and Power Circuits.

An arrangement permitting the use of electric light and power circuits for telegraphy and telephony has been invented by Professor R. B. Goldschmidt, of Brussels. Results obtained by him over 110 or 220-volt lines are said to be equally good. The circuits may at the same time supply any number of electric lights and motors without the slightest disturbance. The transmitting device comprises a sensitive and powerful microphone, capable of withstanding currents of great intensity, which is connected in the circuit of an accumulator, a coil of thick wire and an adjustable resistance for regulating the intensity of the currents through the microphone. The coil forms the primary of a transformer, the secondary of which contains a great number of turns of fine wire of sufficiently high resistance to make the insertion of additional resistances unnecessary, when the secondary is connected to the electric light or power line. When the microphone is spoken into, the voice produces in the secondary circuit of the transformer alternating-current oscillations, which superpose themselves on the direct current flowing through the conductors and, the direct current being scarcely influenced by alternating currents, as is well known, the latter act on the telephone at the receiving end through another transformer, similar to that at the transmitting end. The calling apparatus consists essentially of a toothed-wheel interrupter placed in the circuit, which, when rotated, produces electric currents in the transformer at the receiving end. A sensitive relay connected in the secondary of this transformer serves to establish a local circuit through a battery and bell. A condenser is connected around the interrupter for the prevention of heavy sparks. When the telephone receiver is hung on a hook, the secondary circuit is closed by the relay; when the receiver is removed, the hook rises and the telephone is automatically connected in the secondary circuit of the coil. In order to telegraph it is only necessary to substitute a Morse key for the calling device, and a Morse apparatus or sounder at the receiving end for the bell. Experiments made by Professor Goldschmidt have shown that during the day the transmission is effected as perfectly as over ordinary telegraph and telephone lines, but in the evening, when many local circuits are simultaneously opened and closed, the transmission is a little more difficult. Among the practical applications of the invention are the sending of telegraphic or telephonic messages simultaneously from a central station to a number of subscribers, and communication between central stations and electric railway cars. On account of the high resistance of the transformers the current consumed is almost negligible and the devices are not much more expensive than those ordinarily used.—*Translated and abstracted from L'Electricien (Paris), August* 22.

The Utilization of Electric Power in Salt Mines.

H. R. Speyer describes in this article the generating station which has been built for the joint use of the salt mines owned by the Nordhauser Kali Company, the Immenrode Carnallit Company, and the Ludwigshall Carnallit Company. This group of mines is situated in the midst of the Harz Mountains. The raw material is brought to the surface by electrical main winding engines, and is transmitted to the factory, a distance of some three or four miles, over an electrically driven aerial steel roadway, and is shot from the incoming trucks automatically by electrical tippers into the mills. Issuing from these in a pulverized form, it is taken by conveyers to the top of the building, where it is dropped into the live-steam-heated boilers containing a solution of calcium chloride. Here the original salt, consisting of carnallite and sodium chloride,

undergoes the first chemical change. The carnallite dissolves and the sodium chloride remains in its solid state. The liquid is drawn off and pumped into large open tanks, where the potassium chloride crystallizes out. This is afterwards taken to revolving drying pans fitted with spiral blades, which discharge it in its dry state into hoppers for transmission to the stores. The remaining filtrate is put through various processes for further utilization. The final output is for commercial salts, namely, potassium chloride, magnesium chloride, potassium sulphate and magnesium sulphate. The requirements for producing the commercial salts from the raw material are such that with the exception of live-steam heating for the dissolving boilers, electricity can be used exclusively. The boring operations are carried out electrically; the pit gear, including the underground haulage and winding engines, is driven by electric motors; the transmitting aerial roadway, the tippers, the mills, the hoppers, elevators, pumps, mixing and storing gear, drying plant and cranes for loading, are in each case driven electrically. The power station, when completed, will contain five steam generating sets having an aggregate horse-power of 3,500. The output of the generating machines is controlled from a low-tension control board, while all the high-tension service is in a separate inclosed chamber. The method of control from the low-tension switchboard, including the paralleling of the generators, is by relays actuated by push-buttons mounted on the front of the board. The high-tension switches of the generator cables and of the outgoing feeder cables are all actuated by solenoid coils energized from the low-voltage continuous-current circuit, and controlled from the low-tension board. In order to minimize the risk of a breakdown, the main high-tension distributing cables are laid in pairs. These are at present, however, worked in parallel, and are controlled from one switch panel. Arrangements are to be carried out to enable each feeding cable to be dealt with separately. There are in all five pairs of outgoing main high-tension cables. The transmitting pressure is 5,000 volts. Two substations have been erected, equipped with high and low-tension feeding and distributing switch panels and with static transformers for reducing the transmission voltage to 500 and 110 volts. The former is for small power work, and the latter for the lighting circuits. The electrical equipment at the several pits is described, and an analysis made of the working costs and the excellent results which have thus far been secured.—*Abstracted from Electrical Engineering (London), August 27.*

Some Contact Rectifiers of Electric Currents.

It is not generally known, says L. W. Austin, that there is a large number of solid conductors of electricity, metallic and non-metallic, in which, when brought together so as to form a contact of not too low resistance, electricity appears to pass more easily in one direction than in the other. Most cases of this kind are too uncertain and capricious in their action to allow definite study, but silicon in contact with almost any of the ordinary metals, carbon-steel and tellurium-aluminum, all show a well-marked and fairly regular unilateral conductivity. In the investigation of these contacts the author has used two main methods of experiment. In one a direct electromotive force is applied to a contact, first in one direction and then in the other, and the resulting currents measured on a galvanometer or ammeters having resistances small in comparison with that of the contact. In the second method a known alternating current of sixty cycles is sent through a fall-of-potential wire, and the required voltages taken from sliding contacts and applied to the rectifying contact, which is in series with the direct-current meter. G. W. Packard in 1906 first announced the fact that a piece of silicon, when properly brought in contact with brass or copper, or, in fact, almost any of the common metals, is capable of acting as a detector for electrical oscillations without the use of external electromotive force. The rectifiers used in the experiments were made by embedding a piece of silicon in solder and bringing a bit of brass or steel wire soldered to the end of a flat spring in contact with it. The contact pressure was adjusted by means of a micrometer pressing on the spring from above. As some points on the silicon are more sensitive than others, the contact point is also made adjustable. For the determination of the absolute sensitiveness of the silicon-steel rectifier at high frequencies, a rectifier of rather low sensibility was compared with an extremely sensitive thermo element at a frequency of 140,000. They were connected in turn in series with a one-microfarad paper condenser for stopping the direct current, and with an inductance of 0.0331 microhenry, coupled very loosely to a second tuned circuit in which oscillations were excited. For a set of nine observations, after taking account of the reactance of the coupling coil, the readings on the galvanometer, with the thermo element, indicated a mean alternating electromotive force of 0.0336 volt. The deflection due to the silicon indicated a mean electromotive force of 0.0350 volt, according to the calibration of the rectifier for low-frequency currents. The experiment shows that there is no change in sensitiveness with frequency within the limits of accuracy of the observations. While, in general, the rectified current with silicon rectifiers flows from steel to silicon, an exception was found in a certain sample which was probably less pure in its composition than the rest of the silicon specimens used. In addition to the rectifying effect of tellurium-aluminum contacts, which appears to be thermoelectric, or at least in the same direction as the thermoelectric action, and which becomes irregular above low voltages, there is a second rectifying effect in opposition to the first, which, in general, becomes prominent only at the higher voltages. This second effect seems entirely analogous to the rectification of silicon, and is of the same order of magnitude. The author concludes that in all the cases noticed, the contact has a resistance of several ohms, as though there were a resisting film between the conductors. In all the cases, too, there is a comparatively poor conductor in contact with a good conductor, but the rectification in the cases of carbon-steel and of silicon-steel is from the good to the poor, while in tellurium-aluminum it is in the opposite direction, except for very low voltages, where another phenomenon — perhaps thermoelectric — predominates. It may be worth noting that the first effect is in the same direction as the rectified current in the aluminum electrolytic rectifier. When these surfaces are sufficiently large and the contact sufficiently close, the rectification entirely disappears. Even if the rectified currents were not opposed in direction to the ordinary thermoelectric currents, their magnitude would seem to preclude the possibility of a thermoelectric explanation. Nevertheless, the fact that the direct currents are, in general, roughly proportional to the square of the alternating currents suggests heat action. It may be that there is something of the nature of polarization and a counter-electromotive force at the contact, but if this exists no evidence of it has thus far been found. It is possible that we are dealing with the still obscure question of the escape of electrons from a conductor, and that our rectifying contacts furnish us with conditions under which the electrons pass more readily in one direction than the other; that is, that it is a case of direct, and not secondary, rectification.—*Abstracted from the Bulletin of the Bureau of Standards (Washington), August.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Westinghouse Manhole Transformers.

The accompanying illustrations show the transformers supplied by the Westinghouse Electric and Manufacturing Company to one of the largest electrical companies in the country employing underground distribution. The many advantages of this type of construction have led to its adoption for the entire line of

FIG. 1.—WESTINGHOUSE MANHOLE TRANSFORMERS.

transformers designed for manhole service. These transformers are installed in subway manholes which are liable to flooding from heavy rains or overflow water, and, in addition, these underground chambers are rarely well ventilated. For this reason it is necessary to enclose the transformer in a hermetically sealed case, and design it for an exceedingly low temperature rise.

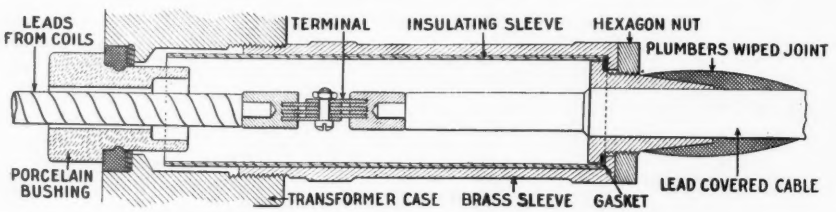


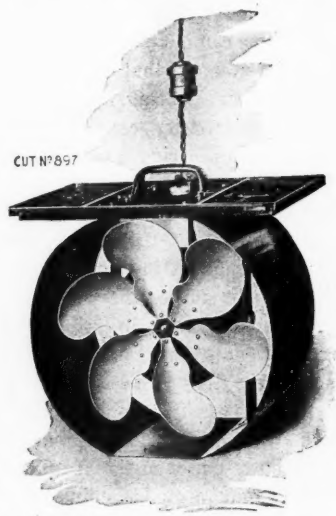
FIG. 2.—DIAGRAM SHOWING CONSTRUCTION OF TERMINAL BUSHING.

The transformers are of the oil-insulated type, and a large air space is left at the top of the case to take care of any expansion of the oil under a rising temperature. Necessarily, this compresses the air in the upper portion of the case and causes a slight rise in pressure. Under abnormal operating conditions, such as a short-circuit, a considerable rise in this pressure may occur, and the transformer case may be seriously injured. In order to avoid any danger from such occurrences a horn-shaped brass casting is used for the oil plug in the cover. The mouth of the horn is closed by a thin sheet of copper which will rupture, acting as a safety or relief valve for any excess pressures. Each case is tested with an air pressure of about ten pounds per square inch and carefully inspected for leakage before shipment.

An improved bushing is used for the leads of these manhole transformers which permits them to be connected to, or disconnected from, the line without removing the cover or otherwise opening the transformer case. This design of bushing eliminates any necessity for breaking the joints of the transformer case and eliminates the danger of water leaking into the transformer through a joint made under difficulties in the confined space available in a manhole. A further advantage of this joint, which is shown in the illustration (Fig. 2), is that it permits transformers of the next larger or smaller size to be substituted in any manhole. Three sizes of bushings cover the full line. The joint is made without any solder except that in the plumber's wiped joint required to connect the lead covering of the cable to the brass sleeve. This is a permanent connection and made when the first transformer is installed. A number of transformers of this design have been arranged to operate on a three-wire, low-tension circuit with a grounded neutral. When this method of operation is used the neutral tap on the low-tension side of the transformer is grounded directly on the transformer case through a stud terminal, as shown in the right-hand view in Fig. 1. The high-tension side of the single-phase transformer, as shown on the left of this figure, is only provided with two outlet bushings.

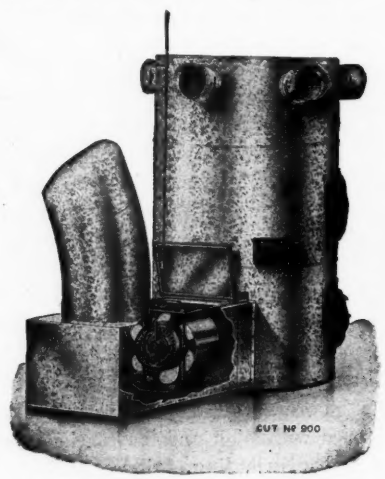
Electric Blowers for Furnaces.

The Emerson Electric Manufacturing Company, St. Louis, Mo., has developed an electric blower for use with ventilating and heating systems, adapted to either al-



ELECTRIC BLOWING UNIT FOR FURNACES.

ternating or direct current. The need is apparent for some aid to natural draft in hot-air furnaces used for heating residences, as the natural air currents from the furnace fail to properly heat one or more rooms in almost every house. Even



ELECTRIC BLOWING UNIT ADAPTED TO RESIDENCE FURNACE.

when the maximum heating power of the ordinary furnace is secured, it is almost certain that some rooms can not be kept comfortably warm. The use of the fur-

nace blower secures a substantial increase in heat from a given quantity of fuel, forcing heated air to the rooms further from the furnace and providing greatly improved ventilation for the entire house.

In the special furnace blower shown in the accompanying illustration there has been developed a fan blower which meets all the requirements of residence service. The blower outfit is placed in the cold-air chamber of the furnace at the back of the furnace. To accommodate the motor an opening of eight and one-half inches by fourteen and three-quarters inches is cut in the top of the cold-air box and provided with a hinged lid or door. The blower outfit is complete, and may be connected by attachment plugs to any convenient electric light socket or receptacle in the cellar.

A Four-Head Tandem Stranding Machine.

The accompanying illustration shows one of the latest products of the New England Butt Company, of Providence, R. I. This is a four-head tandem stranding machine consisting of six, twelve, eighteen and twenty-four spool heads. The machine is used for making concentric cables of small sizes up to sixty-one wires. The spools, which are six inches in diameter, with a three-inch traverse, are carried on pins in such a way as to be easily removable.

The tension device enables the spools to be removed and inserted again without readjustment. The heads are driven by chains from the main shaft, and the alternate heads run in opposite directions. Each head is provided with die holders, adjustable longitudinally, and three sets of dies are furnished with the machine. The take-up sheave is thirty-two inches in diameter and is driven through change gearing which provides for four different lays from two to eight inches. A cross shaft on the front of the machine has a flanged pulley for driving a reel fixture.

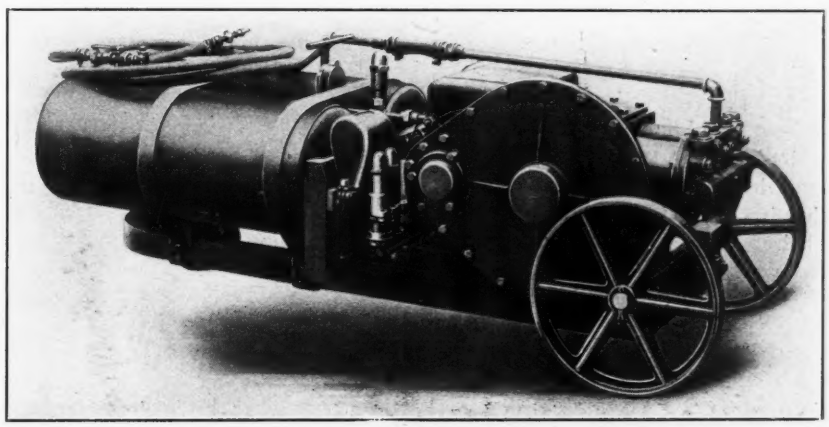
The tight and loose driving pulleys at the rear of the machine are twelve inches in diameter by three and one-half inches wide, and are run at 150 revolutions per minute. This gives the following speeds to the different heads: six-head, 175; twelve-head, 150; eighteen-head, 125; twenty-four-head, 100 revolutions per minute.

A belt-shifter is connected to a rod which runs the entire length of the machine, within easy reach of the operator.

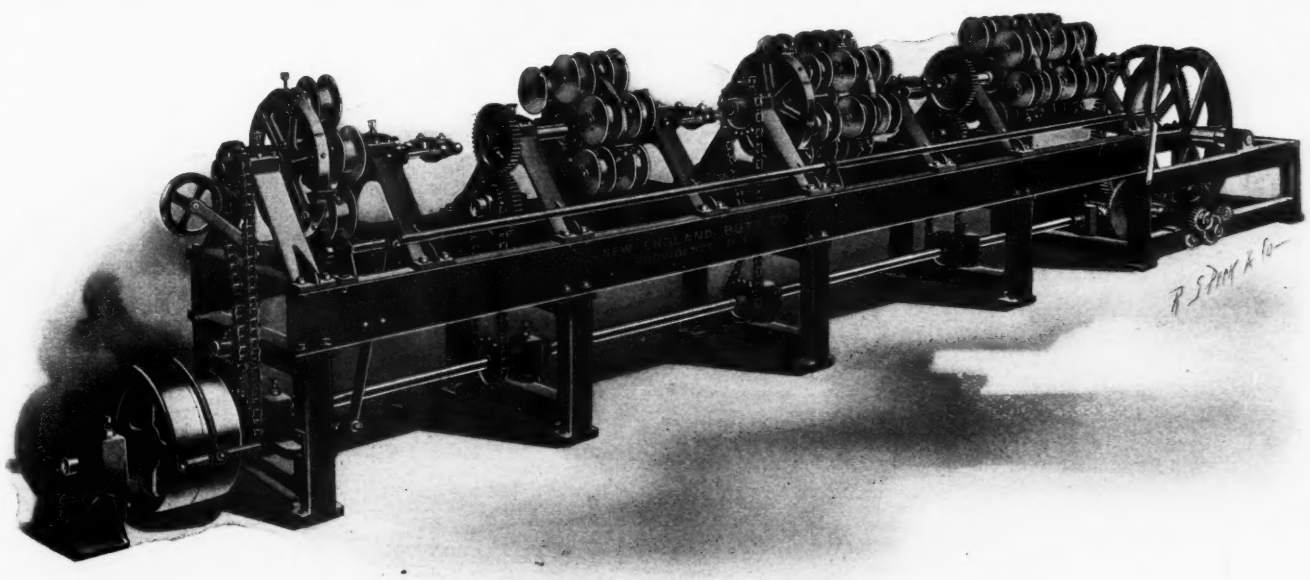
The net weight of the machine is 23,000 pounds, and it takes up a floor space seventeen feet ten and one-half inches by two feet six inches.

A New Horizontal Blowing Outfit.

In response to the demand for a horizontal blowing outfit embracing the same general principles as the standard vertical plant, which has been in successful operation for several years, the Westinghouse Air Brake Company has designed the outfit shown in the illustration. It differs from the vertical plant chiefly in arrangement and more compact construction and is intended for use where conditions do



A New Horizontal Motor-Driven Blowing Outfit.



Four-Head Tandem Stranding Machine.

not permit convenient movement of the vertical apparatus.

Portable plants are now in wide demand for cleaning electrical and other machinery, and for many services for which compressed air is the most convenient and economical agent.

The new horizontal plant consists of a motor-driven air-compressor with one or two brazed reservoirs, an electric pump governor and the usual accessories, such as switch, fuse blocks, gauge, safety valve, insulating hose connection, and hose with nozzle. The truck frame is made of a single piece of standard-shape angle iron bent into the shape of a U, and is cross-braced at the back under the compressor. The rear axle is a piece of square steel bolted directly to the frame. The compressor bed-plate bolts to the frame at each corner. The reservoirs rest upon angle-iron supports and are held firmly in place by means of wrought-iron straps bolted to the frame. A very simple switchboard is placed between reservoirs and compressor, upon which the governor, fuse blocks and switch are mounted. The position of the governor renders it easily accessible for adjustment and maintenance. There is ample room to open the commutator door and examine the brushes. The compressor cylinder head can be removed and the pistons taken out without disturbing the balance of the apparatus.

If it is ever necessary the gear-case cover can be removed by first removing one of the rear wheels, which is easily accomplished. All oil fittings are easily accessible. The rear wheels are eighteen inches in diameter, and the front wheel eight inches in diameter, and the latter can be turned through an angle somewhat greater than 180 degrees. The handle is bent so that when it lies back between the reservoirs the end of it will not protrude above the other apparatus on the truck. When the reservoirs are used they are drilled symmetrically, so that if removed either one can be put back on either side. The width of the outfit is such that it can be run through aisles thirty-one inches wide, and its height is such that it can be stored under a bench if desired. The disposal of the apparatus on the truck brings about two-thirds of the weight on the rear axle.

The type shown in the illustration can be varied in arrangement to suit conditions, and the truck furnished with roller bearings if preferred.

A Contractor's Electric Motor.

The adaptability of electric motors to all sorts of service is well illustrated in the two views herewith of a direct-current motor with a circular saw on the extended shaft. The motor only differs from a type "S" motor of standard Westinghouse design in that the shaft is somewhat larger and longer on the pulley end and that a commutator end bracket is supplied on this end to provide a bearing nearer the saw. The motor speed may be varied from 1,125 to 1,800 revolutions per minute to provide for various classes of work, with saws of different diameters. This motor is rated at ten horse-power.

It will be noted that a pulley has been installed on the extended shaft at the commutator end to act as a flywheel and also to provide a place for a brake. This latter is thrown on by means of a lever near the operator whenever it is desired to stop the saw quickly. The contractor has also installed a bladed fan on the pulley to blow air over the motor and throw the chips and sawdust away from the track and the motor. These can not be seen in the illustrations.

In Fig. 1 a large circular rip-saw is shown for taking a cut in heavy oak timber to be used in dam wickets on the Ohio River. The material must finish ten by twelve. In Fig. 2 a groove cutter is shown in place. A cross-cut saw is also used by the contractor who owns the outfit.

The motor is mounted on a frame with wheels which run on a short piece of track that the saw may be fed through the work. Attention is called to the method adopted by the contractor to keep the track clear of sawdust. In front of all four wheels a flap of leather is arranged to rub on the track which effectually clears away all material and allows the groove cutter to make a cut of even depth at all times.

Mounted on the frame which carries the motor is the switchboard panel with a field rheostat for adjusting the speed, a starting rheostat and a circuit-breaker. As the motor must move back and forth the current is supplied through two short stretches of trolley wire on which the trolley wheels run, similar to the method used in a traveling crane.

From the illustrations it is apparent that the motor is not installed under ideal conditions as the protection from the weather is none too good, but it shows to what purposes motors may be put. The entire outfit is intended by the contractor for portable service as current is supplied from a gas-engine-driven generator which is also mounted for ready handling. There is also a small air-compressor which supplies a pneumatic drill.

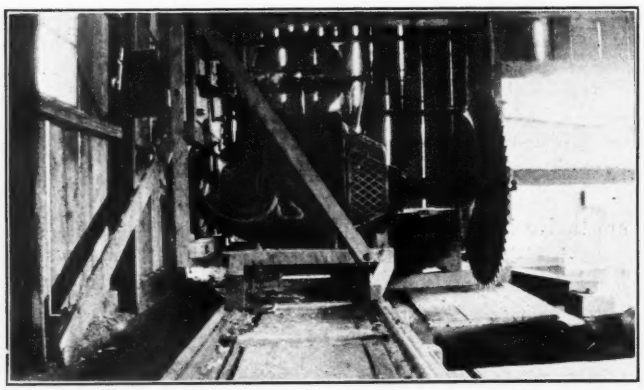


Fig. 1.—Motor Driving Rip Saw.

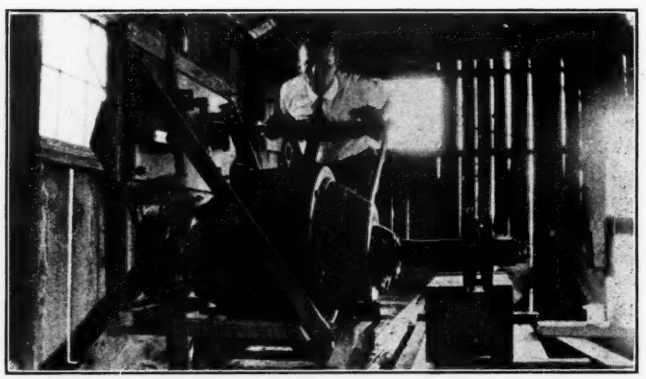


Fig. 2.—Motor Driving Groove Cutter.

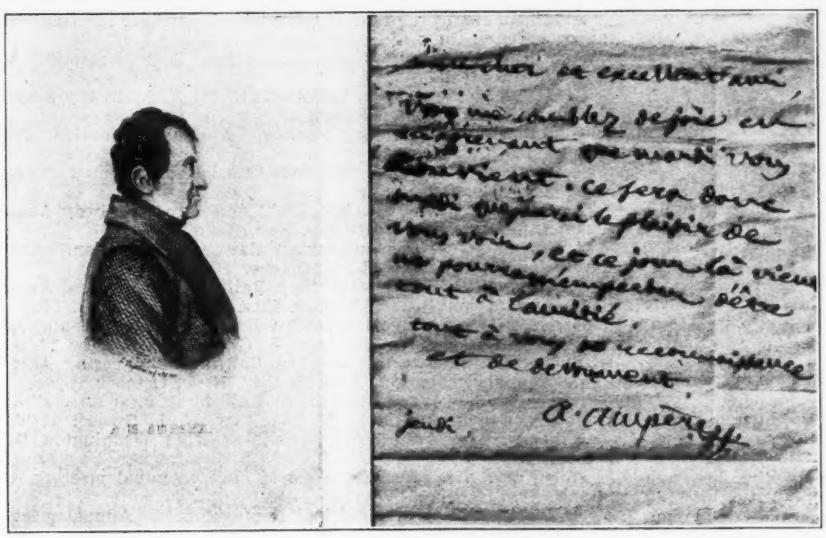
Tungsten in California.

The representative of a foreign steel corporation, says a correspondent in the *Engineering and Mining Journal,* has been some little time in the region of Randsburg and Johannesburg, in Kern County, California, examining various tungsten deposits which have been found there. Some of them, notably the Atolia, have been pretty well developed into productive mines, but most of the claims have not had any extensive work done upon them as yet. It is expected that upon the report of the expert some of the more prominent tungsten mines may be purchased by the foreigners.

Crocker-Wheeler Company Post-Office.

In order to facilitate handling the increasing volume of mail at the Ampere, N. J., post-office, the Crocker-Wheeler Company, manufacturer of electrical machinery, has built a brick and cement post-office building on its grounds. The architecture is of a modern classical style which might be termed "Federal." Upon the pediment above the main entrance is an eagle and United States shield in high relief. The interior of the building is finished in quartered oak and the floor is of mosaic tile. Upon the walls hang a fac-simile of the Declaration of Independence, with the coats of arms of the various states, a Constitution of the United States and an autograph letter and portrait of A. M. Ampere (1775-1836), after whom Ampere is named. The new post-office will still further beautify the grounds of the Crocker-Wheeler Company.

The New Post-Office at Ampere, N. J.



Portrait and Autograph Letter of Ampere in the New Ampere, N. J., Post-Office.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on September 22 for 8,000 feet of telephone cable, two starting panels, six engine telegraphs, for delivery at Mare Island, Cal.; 10,000 feet of fibre conduit, miscellaneous conduit and fittings, and five engine telegraphs, for delivery at Puget Sound, Wash.; miscellaneous arc lamps and miscellaneous wire and sheet platinum for delivery at Brooklyn, N. Y.; miscellaneous electrical supplies and 1,200 steel enameled nipples for delivery at Boston, Mass.

Bids will be opened on September 29 for miscellaneous electrical supplies for delivery at Boston, Mass.; Charleston, S. C., and Brooklyn, N. Y., and for furnishing and installing three transformers at Brooklyn, N. Y.

It is announced that the Bureau of Supplies and Accounts will hereafter accept an annual bond to cover all contracts which may be awarded to one bidder during a fiscal year, instead of requiring a separate bond with each contract, provided such annual bond is executed by a corporate surety company, duly authorized under the act of Congress approved August 13, 1894, to do business as sole surety in United States matters. Blank forms and all necessary information for filing an annual bond will be furnished upon application to the Bureau of Supplies and Accounts.

The Golden West and American Industries Exhibition.

An American exposition, for which all the exhibits will be taken from this country, will be held in the grounds and buildings of Earl's Court, London, England, next year from May to October, under the title of "The Golden West and American Industries Exhibition." A distinguished committee has been organized, headed by the Lord Mayor of London. Representatives have been appointed to visit the leading cities, and all manufacturing districts of the United States, the commissioner in charge of the work being John W. Ryckman. The temporary headquarters of the commission have been established at the Ansonia, Broadway and Seventy-third street, New York city.

The exhibition will typify the great development of the states of the "Golden West" since the discovery of gold in California in 1849, and will also commemorate the bicentennial of the completion of the first Atlantic cable.

The New York Electrical Show.

The New York Electrical Show will be held in Madison Square Garden, New York city, from October 3 to October 14. Plans have been developed to create a number of startling features in the way of exhibit decoration and decorative lighting. The popular application of power will be made a feature of the coming exhibition. It is announced, also, that a series of lectures, twice daily, will be given free of charge in the concert hall.

Thomas A. Edison has signified his willingness to act as president of the exhibition, and on the opening night will be present at Madison Square Garden.

During the show the jubilee of the first Atlantic submarine cable will be celebrated, and the receipts for the evening of Thursday, October 8, will be given to the Loomis Annex.

Current Electrical News

DOMESTIC AND EXPORT.

MONTREAL LIGHT, HEAT AND POWER—A New York syndicate, headed by Leslie Shaw, ex-Secretary of the United States Treasury, has made an offer to the directors of the Montreal Light, Heat and Power Company to purchase the company. The offer is in the shape of a ninety-nine-year lease, the New York syndicate to have the right to purchase the stock at 110.

MONTANA INTERURBAN—The Billings & Cooke City Electric is being organized with $3,000,000 capital to build a line from Absarokee, Mont., northeast to Billings. Surveys are now being made and grading will begin as soon as the right of way is secured. J. B. Clayberg, Helena, Mont.; George E. Savage, Butte; A. L. Babcock, Theodore Martin and Bert G. Shorey, Billings; M. E. Estep, Chicago; Thomas Harney, Galena, Ill., and E. M. Hosky, of Helena, are interested.

NEW JERSEY RAPID TRANSIT COMPANY, INCORPORATED—The New Jersey Rapid Transit Company, with a capital of $1,000,000, has been incorporated at Trenton, N. J., for the purpose of constructing a railroad from the city of Paterson to Suffern, N. Y., a distance of fourteen miles. The incorporators are Thomas J. Maloney, of Jersey City; Henry M. Parmalee, Herbert Bogart, Charles D. Cook and Guy H. Pierce, all of Paterson; M. R. McAdoo, Montclair, and George M. Dunlap, Spring Valley, N. Y.

NOOKSACK VALLEY ROAD FILES INCORPORATION PAPERS—Articles of incorporation have been filed at Bellingham, Wash., for the Nooksack Valley Traction Railway Company, which is surveying a route for the Bellingham-Ferndale Interurban. The incorporation papers state that the purpose of the company is to run lines from Bellingham to Sumas, thus providing for both the Ferndale and Lynden branches. The incorporators are W. P. Alward, J. S. Wheeler, J. E. Morrison and W. H. Jarrett, of Seattle; Edward Brown, of Custer, and Joseph Morrison and J. William Welch, of Ferndale. The capital stock of the company is listed at $1,250,000.

WISCONSIN TRACTION PROPERTY IN HANDS OF NEW COMPANY—With a capitalization of $850,000 the Wisconsin Electric Company has taken over the property of the Winnebago Traction Company, recently sold under foreclosure proceedings. The new company has been authorized to issue $1,500,000 in bonds. The officers of the Wisconsin Electric Company are: President, O. C. Fuller; secretary, Fred C. Best; treasurer, R. C. Smith; manager, C. C. Smith. The company will operate the Oshkosh city lines and the interurban lines in conjunction with the Eastern Wisconsin Electric Railway Company between Oshkosh and Fond du Lac formerly operated by rival interests.

$10,000,000 COMPANY TO BUILD KANSAS INTERURBANS—The organization of the Interstate Railway and Power Company, which will build and operate a network of trolley lines covering eastern and southern Kansas, with a main interurban line between Kansas City and Topeka by the way of Lawrence, has been completed. With this has been organized the Kansas City Union Trust Company, a $10,000,000 corporation, which is to finance the deal. Headquarters of both companies are to be in Kansas City, and men of that city are the most active promoters of the proposition. It is announced that $8,000,000 of the proposed capital of the Kansas City Union Trust Company has been arranged by financiers of Liverpool. The remainder has been subscribed or is to be subscribed in the district where the new lines are to be operated.

KANSAS-COLORADO ELECTRIC LINE—The Kansas-Colorado Railroad Company, organized recently at Pueblo, Col., to build a trolley system in the Arkansas Valley from Pueblo as far east as Dodge City, Kas., has applied to the Kansas Charter Board for authority to engage in business in the state. The original company was chartered under the laws of Colorado and its headquarters are at Pueblo. The company says its object is to construct and operate either a standard-gauge steam or electric road from Pueblo east to Dodge City, taking in these Kansas towns: Coolidge, Syracuse, Lakin, Deerfield, Garden City, Pierceville, Ingalls, Cimarron and Dodge City. Branch lines are provided for to Scott City and other towns in that section of the state. It wants authority to build the road, electric-plants and telegraph and telephone systems. Its capital is placed at $5,000,000. Most of the men interested in the concern live in Colorado. The Kansas men on the board of directors are W. P. Humphrey, Syracuse; A. C. Campbell, Lakin; Andrew Russell, Dodge City, and A. H. Warner, Garden City.

PROPOSED EXTENSION OF TRANSIT FACILITIES IN PHILADELPHIA—An ordinance providing for an increase of the city of Philadelphia's indebtedness $4,000,000, with which to build an elevated railroad from Front and Market streets to the Torresdale Boulevard, has been introduced in select council by James Emery Byram. The bill was referred to the street railway committee. The ordinance authorizes the mayor to enter into a contract for the construction of the railway from Front and Market streets to the terminal at the Torresdale Boulevard. It is provided that the city shall lease the road to the highest bidder. Funds with which the city is to build the road are to be obtained by increasing the indebtedness by $4,000,000, the loan proposition to be submitted to a vote of the people. Such a railroad would tap a territory embracing more than forty-three square miles and containing a population of more than 324,000. It would afford quick transit facilities to residents of Frankford, Kensington, Richmond, Bridesburg and the eastern side of old Coopersville, which is now the thirty-third ward.

DATES AHEAD.

American Institute of Mining Engineers. Annual meeting, Chattanooga, Tenn., week of September 29.

American Electrotherapeutic Association. Annual meeting, New York city, September 22-24.

Central Electric Railway Association. Next bi-monthly meeting, Indianapolis, Ind., September 24.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 5-6.

Empire State Gas and Electric Association. Annual meeting, New York city, October 7.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Pittsburg, Kan., October 8-9.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

Railway Signal Association. Annual meeting, Washington, D. C., October 13-15.

Order of the Rejuvenated Sons of Jove. Annual meeting, Buffalo, N. Y., October 15-16.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October 20-23.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Association of Car-Lighting Engineers. First annual meeting, Chicago, Ill., November 18.

NEW MANUFACTURING COMPANIES.

BOSTON, MASS.—The Universal Electric Light, Power and Machine Company has been incorporated to deal in electrical supplies. The capital stock is $100,000. Albert L. Farr, of Stonington, Me., is president and treasurer.

WILMINGTON, DEL.—The Automatic Cashier Machine Company has been incorporated to manufacture electrical apparatus. The incorporators are J. Charles Righter, Samuel Vance, Jr., both of Philadelphia, and Harry W. Davies, of Wilmington. The capital stock is $300,000.

ELECTRIC LIGHTING.

BELLEFONTAINE, OHIO—The West Liberty electric plant has been sold to R. M. Keller, of Washington, for $10,000.

SIOUX FALLS, S. D.—The business men and other residents of Scotland have decided in favor of an electric lighting system.

ROCKFORD, ILL.—Improvements to cost in the neighborhood of $40,000 to $50,000 are contemplated by the Rockford Electric Company.

DAYTONA, FLA.—The Daytona electric light plant, which was recently destroyed by fire, will be rebuilt. Bonds have also been voted for a city waterworks plant.

BASTROP, TEX.—The Bastrop Water and Light Plant, including fixtures for the ice factory, was sold at public sale to T. A. Hasler for $12,281.40, one dollar more than the indebtedness on the plant.

CLINTON, MASS.—The Marlboro Electric Lighting Company has entered into an agreement with the Connecticut River Power Company to secure a portion of its electric power from the plant at Vernon, Vt.

NORTH PLATTE, NEB.—The electric light company has greatly enlarged its plant within recent months, the latest improvement being the installation of a new 250-horse-power boiler and a 150-kilowatt dynamo.

LEXINGTON, KY.—The Kentucky Water, Heating and Illuminating Company, John A. Gary, president, has bought for $6,100 the franchise for a new electric lighting plant in this city, auctioned by Mayor Skain.

ARVADA, COL.—A special election has been called for September 22 at which the citizens will vote upon the matter of granting a franchise to a newly organized company which purposes to light the town with electricity.

LOGANSPORT, IND.—The contract for the new equipment to be installed in the Logansport municipal electric and power plant has been awarded to the Westinghouse Electric and Manufacturing Company at its bid of $27,907.94.

CORPUS CHRISTI, TEX.—A charter has been granted to the People's Light Company, of this city, which will at once begin the installation of a $30,000 electric power and ice plant. This will be the second plant of the kind to be installed in Corpus Christi.

SALISBURY, N. C.—The Southern Power Company is now supplying current to the Salisbury & Spencer Street Railway Company, in this city. The current is conveyed a distance of 104 miles and its use increases the capacity of the Salisbury electric plant from 600 to 4,000 horse-power.

BUFFALO, N. Y.—The Buffalo General Electric Company has built a transformer station for the purpose of delivering power and lights, both arc and incandescent, to the Lackawanna district of West Seneca. The company will tap the wires of the Niagara, Lockport & Ontario Power Company.

NORFOLK, CT.—Excavations have been begun for the foundation of a building on the site of the Southern New England Telephone Company office, which was destroyed by fire several years ago. When completed the new building will be used as a substation by the Berkshire Power Company.

BANGOR, ME.—The Bar Harbor & Union River Power Company has its line completed from the power plant in Ellsworth to Bar Harbor, a distance of about twenty-three miles. Light and power are now being transmitted from Ellsworth to Bar Harbor, and a line is being built to Bangor.

LIVE OAK, CAL.—The Live Oak & Encinal Lighting Corporation is being formed by Live Oak business men. It is proposed to run wires from the substation at Encinal along the public road to Live Oak and place lights on about every third pole that carries the wires of the Bay Counties Power Company.

BOYSEN, WYO.—Work on the dam of the Big Horn Power Company, which was suspended several months ago when a controversy as to the height of the dam arose, has been resumed. The dam will be thirty-five feet in height and will make possible the generation of 10,000 electrical horse-power from the flow of the Big Horn River.

NIAGARA FALLS, N. Y.—The Ontario Power Company is constructing an entirely new transmission line to Welland, Ontario. At the river, west of Niagara Falls, Ontario, the poles are seventy-five feet high. Three cables have been strung and three more are to be added. From the river the company has its own right of way paralleling the line of the Michigan Central Railway.

MACUNGIE, PA.—At a meeting of citizens the Macungie Electric Light, Heat and Power Company was organized. Charles H. Neumoyer was elected president of the company; Postmaster H. L. Hertzog, treasurer; W. N. Decker, secretary; Charles Boettger, H. B. Weaver, C. O. Shimer, Adam B. Neumoyer and Charles H. Neumoyer, directors. The capital stock was placed at $5,000.

TABOR, IOWA—On September 21 the people of Tabor will vote on the granting of a franchise to the Malvern Light and Power Company. This company proposes to run a wire from its plant at Malvern to supply the necessary current. It will cost the Malvern concern $15,000 to enlarge its plant for this purpose. To aid in the enterprise thirty-five citizens of Tabor have subscribed for $7,500 of the bonds.

BUFFALO, N. Y.—Plans for the proposed electric lighting system at the city hall will soon be completed by J. J. O'Leary, the electrical expert engaged by the board of trustees for that work. Mr. O'Leary and Trustees Bisgood, Zittel and Steul have returned from a trip of inspection to Harrisburg, Pa.; Philadelphia, Pa.; Washington, D. C.; Baltimore, Md.; Trenton, N. J.; New York city and Syracuse, where they examined the lighting systems of the public buildings.

WAUWATOSA, WIS.—The common council has entered into a five-year contract with the Milwaukee Electric Railway and Light Company under which the company will at once install a system of Nernst lamps. A total of 112 of these lights will be placed, with possibly twenty-seven more within a short time. The contract is for an all-night service, the city to pay $21 per lamp per year. In order to operate these lights it will be necessary for the company to rewire a part of its system.

SANTA ROSA, CAL.—At the annual meeting of the Cloverdale Light and Power Company A. Sbarboro was chosen president, P. C. Rossi vice-president, and A. E. Sbarboro secretary and manager. C. A. Feldmeyer was reappointed superintendent of the company. The work of the past year was found to be very satisfactory and it was planned to extend the lines of the company north and south of Cloverdale, and also to cross the Russian River and supply light and power for the many residences in the rural section there.

ASHEVILLE, N. C.—Extensive improvements are to be made by the Asheville Electric Company. The expenditure will amount to between $25,000 and $30,000 for new transformers, switchboards and other apparatus for utilizing the current obtained from the Weaver Power Company as well as the reserve of the steam plant. On account of the increased business of the company the new equipment will be more extensive than that which it will replace and, to accommodate it, an addition to the power-house, costing about $5,000, will be required.

FALL RIVER, MASS.—At the annual meeting of the Tiverton Electric Light Company officers were re-elected as follows: President, John R. Hicks; clerk, George R. Lawton; treasurer, Owen Durfee. Directors: Edward L. Anthony, Rufus W. Bassett, Robert S. Goff, Albert F. Dow, Frederick O. Dodge, Fall River; John R. Hicks, George R. Lawton, Tiverton. It was reported at the meeting that the work of constructing the lines in Tiverton would probably be begun at an early date. The power will probably be furnished by the Fall River Electric Light Company.

NEW PUBLICATION.

"THE FUTURE OF ELECTRICITY"—The New York Electrical Trade School has reprinted a lecture entitled "The Future of Electricity," which was delivered to the students of the school by Professor Charles P. Steinmetz in the lecture hall of the American Institute of Electrical Engineers last fall. This lecture is full of helpful and hopeful information for the younger man, and its reading will prove a decided stimulus to the student who is ambitious to succeed and become a factor of importance in his chosen profession.

ELECTRIC RAILWAYS.

KANSAS CITY, MO.—The Kansas City & Olathe Electric Railway has been completed between Rosedale and Shawnee.

MACON, GA.—The Macon Railway and Light Company is installing new machinery in its power plant in Macon. More than $50,000 will be expended.

ROCHESTER, N. Y.—The Buffalo, Lockport & Rochester electric line is now in operation as far as Albion. It is hoped to have the system completed to Buffalo by November 1.

STERLING, ILL.—The people of Tampico Township have raised the sum of $15,000 for the purchase of bonds of the new interurban line that is being proposed between Tampico and Hooppole.

LITTLE ROCK, ARK.—A 1,500-horse-power turbine engine is being installed in the power house of the Little Rock Railway and Electric Company. The new engine is one of the largest in use in the South.

MARSHALL, TEX.—Marin Turney has made application for a franchise to build an electric car line in the city. He guarantees to build one and three-quarters miles of track and to operate the same within the first thirteen months.

CAIRO, ILL.—Announcement is made that the Cairo Electric Traction Company and Cairo City Gas Company have been bought by the McKinley traction system, which will control all the public lighting and traction facilities of this city.

NEW CASTLE, PA.—James Strawhecker, of Zelienople, president of the proposed Wampum-New Castle street railway, states that he expects to begin active work in a short time. The line is to come through West Pittsburg and South New Castle borough.

DULUTH, MINN.—The Duluth Street Railway Company, now operating under a franchise which still has twenty-three years to run, has applied to the secretary of state for new articles of incorporation to extend fifty years from date, with a capital of $1,500,000.

LAPORTE, IND.—Electric cars will run direct between Michigan City and Louisville within eight weeks. The recent completion of the Laporte extension of the Murdock lines leaves but one small gap, that between Peru and Warsaw. Three cars will make the trip each day.

OKLAHOMA CITY, OKLA.—Information has been received from G. B. Stone, the president of the Chamber of Commerce, who is now traveling in Europe, to the effect that a company made up of Vienna capitalists is being organized for the construction of a trolley line from Oklahoma City to Wichita Falls, Tex.

HASTINGS, PA.—The Barnesboro Construction Company has been awarded a contract by the Northern Cambria Street Railway Company for the construction of an extension of the system from Barnesboro to Hastings. The street railway company has already invested $400,000 in its line from Patton to Barnesboro.

REDWOOD CITY, CAL.—Supposedly representing the interests of the Southern Pacific Company in its plans to spread a network of electric railways throughout the peninsula, S. M. Snyder, a realty promoter and agent for North Fair Oaks, has secured the consideration of the trustees to his plan for an electric road through the city.

CHESTER, PA.—A movement has been begun to establish a trolley line between this city and West Chester, the route of the proposed road to pass through Village Green, Concord, Thornton and Westtown. All the property owners in that section are in favor of the project. It is expected that the road will be staked out at an early date.

OKLAHOMA CITY, OKLA.—Surveys on an interurban electric line from El Reno to Oklahoma City by way of Yukon have been started. The road will parallel the Rock Island tracks between Yukon and El Reno, touch the Oklahoma City street railway system at Belle Isle and enter Oklahoma City over the local company's tracks. Maney Brothers and Henry Schafer, promoters, have applied for an increase in capital stock from $25,000 to $1,000,000. The line will be known as the El Reno Cable and Trolley Company.

GOUVERNEUR, N. Y.—A trolley road is proposed for this section of the state. A. A. Potter, in behalf of the parties interested, has circulated a petition among the business men of this village asking them to agree to give the company their freight business. The petition receives the signature of practically every firm. The right of way of the entire distance of 100 miles has been secured, and as soon as the franchise is granted a survey of the proposed route will be made and active operations on the construction of the road begun.

HAMILTON, OHIO—Stockholders of the Cincinnati Northern Traction Company have elected the following directors: George B. Cox, Bensom Fodaker, Charles Richardson, N. S. Keith and L. A. Ireton, of Cincinnati; O. V. Parrish, Peter Schwab and W. C. Shepherd, of Hamilton. The directors elected George B. Cox president, W. C. Shepherd vice-president, and F. R. Williams, of Cincinnati, secretary and treasurer.

DES MOINES, IOWA—George W. Adams, president of the Iowa & Omaha Short Line Railway Company, states that the preliminary work is well under way and actual construction on the new line will begin the coming spring. Most of the right of way has been taken and the surveyors are in the field. The line as proposed will run from Des Moines to Omaha by way of Dallas Center, Panora, North Branch, Exira, Elkhorn, Walnut, Oakland, Carson, Treynor and Council Bluffs.

ASHEVILLE, N. C.—On application of the Asheville Electric Company and other creditors, the Asheville Rapid Transit Company, on its admitted inability to meet its liabilities, has been placed in the hands of a receiver, Judge Ward appointing John P. Arthur to take charge of the property. Under order of the court the receiver will operate the railway, as at present, from the Golf Links station to Craggy station, a distance of five miles, but no effort will be made to operate the Overlook Park line from the Golf station to the top of Sunset Mountain.

BATH, N. Y.—There is a possibility that the Sodus Bay Railroad which was abandoned thirty years ago, when it was finished and ready for the rolling stock, may be constructed. Former Congressman Haines, with several capitalists and railway promoters, has been looking over the roadbed. The promoters entertain the idea that it would be feasible to build the road as an electric line. The Sodus Bay road was abandoned because several of its principal promoters yielded to the interests of the Fall Brook road, which paralleled the Sodus Bay line from Corning to Lyons.

ASHEVILLE, N. C.—Work on the construction of the electric line from Weaverville to Asheville, a distance of nine miles, is now well under way, and it is expected that the grading and trestle work will all be completed within sixty days. It is the purpose of the Weaverville Electric Company, the corporation building the road, to have cars in operation by late fall. It is learned that the promoters of the Weaverville-Asheville electric line purpose extending the line further into North Buncombe and make it penetrate the Barnardsville section and on to the Yancey county line. It is believed that the line will ultimately be extended to Burnsville, in Yancey County.

HUNTSVILLE, ALA.—A controlling interest in the Huntsville Railway, Light and Power Company is said to have been acquired by Ed. L. Pulley and his associates, who have incorporated the Huntsville, Chattanooga & Birmingham Railway, Light and Power Company. The incorporators are Mrs. Jimmie V. Lowry, of Huntsville; Dr. William J. Pulley, of New York; N. O. Wallace, of Fayetteville; Charles H. Pulley and Ed. L. Pulley, of Huntsville. Officers have been elected as follows Mrs. Jimmie Lowry, president; Dr. Wm. J. Pulley, vice-president; N. O. Wallace, secretary; Charles H. Pulley, treasurer, and Ed. L. Pulley, general manager. The authorized capital stock is $50,000, of which $31,000 has been paid in.

GALESBURG, ILL.—The Galesburg, Aledo & Northwestern Railroad Company has been organized with a capital of $10,000 to run through the counties of Knox, Warren and Mercer to the city of Aledo. The road will then proceed through Rock Island County to Rock Island, and thence to Muscatine, Iowa. The articles of incorporation call for a charter of fifty years' duration, the government of the company to be in the hands of a board of directors and such executive officers as may be provided for in the by-laws. The prospects for the line are growing brighter each day and at present practically all doubt as to the building of the road has disappeared. The subscription books will be opened and work on the line commenced in a few weeks.

PERSONAL MENTION.

MR. H. A. GRANT has assumed the position of general manager of the Orlando Water and Light Company, of Orlando, Fla. Mr. Grant has had a wide experience in the electrical field, having been identified with the Florida Electric Company, of Jacksonville, Fla., for the past seven years.

MR. C. M. NININGER has been appointed district commercial manager of the Southern Bell Telephone and Telegraph Company, with headquarters at Montgomery, Ala., succeeding Edward Lyle, who has been promoted to the position of general right of way agent, with headquarters at Atlanta, Ga.

MR. WALTER P. SCHWABE has been appointed manager of the Northern Connecticut Light and Power Company, succeeding Parker H. Kemble, who has hitherto acted as both president and manager of the company. Mr. Schwabe for fifteen years was in charge of the Rutherford (N. J.) plant of the Public Service Corporation of New Jersey.

MR. CLARENCE GIBSON, formerly manager of the Uniontown (Pa.) district of the Bell Telephone Company, has been placed in charge of the Washington, Pa., district, succeeding J. H. Clune, who has been made superintendent of the Butler exchange. Ernest Ritter, district manager of the company at Easton, Pa., has been transferred to Allentown in order to keep in closer touch with the plant and traffic department which is located at that place. The Easton office is now under the management of R. D. Frame.

OBITUARY NOTES.

DR. HENRI BECQUEREL died in Paris, France, last month, at the age of fifty-six. Although it is to his pupils, the Curies, that the discovery of radium is due, this discovery was made in carrying out a systematic research to investigate the cause of the invisible rays which Becquerel had found to be emitted by certain compounds of uranium. His announcement that photographic plates enclosed in a light-tight box with uranium salts were acted upon actinically was at first received with a considerable amount of skepticism, but this, on the whole, formed the basis of the field of research which since that time has opened up.

PROFESSOR E. E. N. MASCART died at Paris, France, on Tuesday, August 25, at the age of seventy-one. After graduating from the College of Valenciennes at the age of nineteen, Mascart became a teacher at the Lycées of Lille and Douai. In 1858 he entered the Ecole Normale Superieure, where, after completing his course, he remained until 1864 as assistant on the teaching staff. After filling chairs of physics at Metz and Marseilles he was called in 1868 to Paris to take the position at the College of France of adjunct professor to Renault. On the death of the latter he succeeded to the full professorship. During the Franco-Prussian war he served as assistant director of the cartridge and arms factory at Bayonne. In 1878 he was appointed director of the Central Meteorological Bureau of France, from which position he retired only recently on account of ill-health. In 1878 he published his "Treatise on Static Electricity," in two volumes, and between 1882 and 1886 his work entitled "Lessons in Electricity and Magnetism," which he prepared with Professor Joubert as collaborator, appeared. In 1892 he published his "Treatise on Optics," and in 1900 his "Treatise on Terrestrial Magnetism." During the greater part of his life he was one of the most active figures in the scientific circles of Paris. He was a member of the Academy of Sciences, and served as president of the Physical Society, the International Society of Electricians, the Meteorological Society and the Association for the Advancement of Science. He served also as president of the Committee on Commerce and Manufactures attached to the French Ministry of Commerce and as president of the Commission of Inventions for the Army and Navy. He took a leading part in the several international electrical congresses held in Paris, namely, those of 1881, 1889 and 1900, and was a delegate of the French Government to the International Electrical Congress of Chicago in 1893. He was a Grand Commander of the Legion of Honor.

ELECTRICAL SECURITIES.

The course of the market was generally downward and irregular all last week, some of the declines assuming considerable proportions. A feature of the selling was the aggressive bear pressure and the liquidation of stock which had been held for some time. The adverse factors appear to be the inclination toward a firmer money market, with advance in foreign exchange, and the passing of dividends by several prominent industrials. The government crop report was not considered especially satisfactory, but, on the other hand, a very favorable development was the court decision declaring the commodity clause of the Hepburn act unconstitutional. Developments indicate that the return to industrial activity is to continue comparatively slow. A compilation of railroad earnings for the first six months of this year shows a gross decrease of $235,000,000, while the net loss appears to be about $65,000,000. For the month of August the gross decreased 13.8 per cent, while for July the gross loss was 17.2 per cent, the net decreasing 8.1 per cent.

Dividends have been declared upon the following electrical securities: United Gas Improvement Company; regular quarterly dividend of 2 per cent, payable October 15 to stock of record September 30. Chicago Telephone Company; regular quarterly dividend of 2½ per cent, payable September 30; books close September 26, reopen October 1. Quarterly dividend of 1¾ per cent on the stock of the Manhattan Railway Company, guaranteed by the Interborough Rapid Transit Company, payable October 1 to stock of record September 11. United Traction and Electric Company; regular quarterly dividend of 1¼ per cent, payable October 1. Cumberland Telephone and Telegraph Company; have declared a quarterly dividend of 2 per cent, payable to stock of record September 20; this is an increase of ¼ per cent quarterly, the rate heretofore having been 1¾ per cent quarterly. West End Street Railway Company; regular semiannual dividend of $1.75 on the common stock, payable October 1; books close September 21 and reopen October 2. Portland Railway, Light and Power Company of Oregon; regular quarterly dividend of 1¼ per cent on the preferred stock, payable October 1 to stock of record September 15. Houghton County Street Railway Company; regular semiannual dividend of 3 per cent on the preferred stock, payable October 1 to stock of record September 15. Toronto Railway Company; regular quarterly dividend of 1½ per cent, payable October 1 to stock of record September 15. Union Traction Company, of Indiana; regular semiannual dividend of 2½ per cent on the preferred stock, payable October 1 to stock of record September 25. Western Union Telegraph Company; quarterly dividend of ½ per cent, payable October 15. Halifax Electric Tramway, Limited; quarterly dividend of 1½ per cent, payable October 1. Ridge Avenue Passenger Railway; quarterly dividend of $3 per share; guaranteed by Philadelphia Traction Company, lessee.

ELECTRICAL SECURITIES FOR THE WEEK ENDED SEPTEMBER 12.

New York:	*Closing.*
Allis-Chalmers common	10½
Allis-Chalmers preferred	34¼
Brooklyn Rapid Transit	52¾
Consolidated Gas	151¼
General Electric	143
Interborough-Metropolitan common	11¾
Interborough-Metropolitan preferred	32½
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	67¼
Mackay Companies (Postal Telegraph and Cables) preferred	69
Manhattan Elevated	135
Metropolitan Street Railway	29½
New York & New Jersey Telephone	113½
Western Union	60¼
Westinghouse Manufacturing Company	74½

Boston:	*Closing.*
American Telephone and Telegraph	129
Edison Electric Illuminating	230
Massachusetts Electric	47
New England Telephone	118
Western Telephone and Telegraph preferred	75

Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	38
Electric Storage Battery, preferred	38
Philadelphia Electric	9¾
Philadelphia Rapid Transit	20¾
United Gas Improvement	87¾

Chicago:	*Closing.*
Chicago Telephone	151
Commonwealth Edison	107
Metropolitan Elevated preferred	44
National Carbon common	70
National Carbon preferred	109

NEW INCORPORATIONS.

STAUNTON, VA.—Shenandoah Electric Company. $10,000.

AU SABLE, MICH.—Eastern Michigan Power Company. $10,000.

HARRISBURG, PA.—Portersville Telephone Company, Portersville. $12,000.

SPRINGFIELD, ILL.—Chatsworth Electric Company. To furnish light, heat and power. $25,000. Incorporators: L. A. Walter, J. B. Grotevant, G. W. McCabe, Chatsworth.

INDIANAPOLIS, IND.—Morgantown Light and Power Company, Morgantown. $5,000. Directors: William T. Gibson, Jesse H. Deer, James A. Collett, Joseph H. Enos and William W. Davis.

INDIANAPOLIS, IND.—Public Service Telephone Company, Leesburg. $20,000. Directors: Abraham H. Brown, Frank Bortz, Henry E. Kinsey, John E. Armstrong and Walter H. Stanley.

HARRISBURG, PA.—Carrick & Baldwin Street Railway Company. $6,000. Officers: F. K. Martin, Pittsburg, president; J. C. Bily, F. K. Martin, J. G. Evans, S. T. Tone and W. B. Carson, directors.

COLUMBUS, OHIO—Perry Electric Company, of Crooksville. $10,000. To establish and maintain an electric power plant at Crooksville. Incorporators. J. Edward Horn, J. C. Horn, Charles W. Runk, W. M. Runk and W. W. Hardy.

INDIANAPOLIS, IND.—Logansport, Frankfort & Indianapolis Traction Company. To build an interurban line from Frankfort to Logansport. $25,000. Samuel H. Blakeslee and Allen G. Barone, of Cleveland, and Fred Cook, of Indianapolis.

FAIRMONT, W. VA.—Independent Power and Light Company, of Fairmont. $150,000. To erect electric plants and perform all the functions to which such a plant can be applied. Incorporators: A. H. Donnally, L. C. Wyer, J. R. Linn, J. T. Hill, C. E. Mayers, all of Fairmont.

JOHNSON CITY, TENN.—Unaka Traction Company. To build a street railway from Erwin to Johnson City, through Unaka Springs, to be operated by horse, steam or electric power. $10,000. Incorporators: Isaac Love, W. B. McNabb, A. M. White, F. B. Vines and J. A. Wilson.

CHICAGO, ILL.—Chicago, Wheaton & Western Railway. To tap the region north of Wheaton, Ill., and connect with the Aurora, Elgin & Chicago electric line. $10,000. Incorporators: J. Sidney Condit, J. Percy Strickland, D. W. Peters, R. B. Tabor and H. C. Wood, all of Chicago.

INDIANAPOLIS, IND.—Valparaiso & Northern Railway Company. To construct, maintain and operate street and interurban railroads in Indiana. Its lines will run from Valparaiso, in Porter County, to and in the town of Chesterton. The concern is capitalized at $10,000. Chicago capitalists are named as the incorporators.

WHEELING, W. VA.—Wheeling, Cadiz & Tuscarawas Traction Company, Cadiz. To build a road connecting Bridgeport and Uhrichsville, and passing through Belmont, Jefferson, Harrison and Tuscarawas counties. $10,000. Incorporators: Barclay W. Rowland, Charles L. Scott, Charles F. Branson, William T. Perry, John F. Kennedy and G. W. Grissinger.

EVANSVILLE, IND.—Evansville & Eastern Railway Company, of Evansville. To construct and operate street railway and interurban companies in Indiana and to furnish lighting facilities to Indiana cities and elsewhere. $10,000. Incorporators: John C. Lake, of Lake, Ind.; Marcus S. Sonntag, W. H. McCurdy, Albert F. Karges, William A. Koch and C. H. Battin, of Evansville.

OMAHA, NEB.—Independent Transportation Company, of Council Bluffs. $30,000, consisting of 6,000 shares at a par value of $5. Incorporators: William Leahy, J. R. McPherson, Henry Sperling, J. R. Reed and A. T. Flickinger, of Council Bluffs. To carry on a general transportation business, including the carrying of persons and property in this city and adjacent territory. Officers: William Leahy, president; J. R. McPherson, vice-president; Henry Sperling, secretary; J. R. Reed, treasurer.

TELEPHONE AND TELEGRAPH.

ANAHUAC, TEX.—A telephone line has been constructed between Stowell and Anahuac.

MIDDLETOWN, OHIO—The consolidation of the Bell and the independent telephone companies at West Elkton was effected recently, when the subscribers of the Bell company were transferred to the independent company.

BOSTON, MASS.—The New England Telephone and Telegraph Company has secured control of the Northeastern Telephone Company, the Lewiston-Auburn Telephone Company and the Cumberland Telephone Company, three independents, operating in some twenty-five towns and cities in Maine.

WINSTON-SALEM, N. C.—Manager E. H. Wilson, of the Southern Bell Telephone Company, reports that the company will be in its new quarters by the middle of October. A new switchboard is being installed and the old equipment in the present office in the municipal building will be discarded.

MAUCH CHUNK, PA.—At a meeting of the stockholders of the Carbon Telephone Company, an independent line between Coal Dale and Summit Hill, it was decided to improve the service by extending the line to Tamaqua on the west and Nesquehoning on the east, and connect at both places with the United Telephone and Telegraph Company's lines.

ST. JOSEPH, MO.—The Agency Telephone Company's exchange, including all of the wires, instruments and reserve stock, has been sold to the Clinton County Mutual Telephone Company, of Plattsburg, by Dr. F. C. Owens, of Big Horn, Mont. Three considerations entered into the transaction. The purchaser paid Dr. Owens $1,000, released a debt of $300 due from Owens, and paid to E. W. Miller, of Agency, $4,532.56, secured by a mortgage on the plant. Suit against Dr. Owens for $300 was instituted in circuit court July 16 by the Plattsburg company, which alleged that it had been engaged to repair the Agency lines, and that it had performed services in March, April, May, June and July without recompense. The suit now will be dismissed.

INDUSTRIAL ITEMS.

THE ANDRESEN-EVANS COMPANY, Monadnock Building, Chicago, Ill., has published a handsome catalogue devoted to ore and coal-handling plants and grab buckets.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., in bulletin No. 1,111, describes and illustrates electric motor drives applied to machine tools. This is a very interesting bulletin and should be in the hands of all those interested in this phase of motor application.

THE MINNEAPOLIS STEEL AND MACHINERY COMPANY, Minneapolis, Minn., announces that the Clarkfield Roller Mills and Electric Light Company, of Clarkfield, Minn., has placed an order for an eighty-horse-power Muenzel producer gas engine and suction gas producer for running its mill and electric light plant.

THE HARVARD ELECTRIC COMPANY, 66 West Van Buren street, Chicago, Ill., announces that although its main factory and stock were seriously damaged by fire on August 28, it is in a position to take care of all orders. The eastern territory will continue to be supplied from the New York city office, and the Chicago factory has recommenced work with sufficient force to fill all orders promptly.

THE COLONIAL SIGN AND INSULATOR COMPANY, Akron, Ohio, has issued an attractive booklet devoted to special porcelain for special purposes. This booklet describes a number of interesting types of fuse-box porcelains, lightning arresters, combination cutouts, pendent signs, condulet covers, attachment plugs, panel terminals, switches, telephone accessories, third-rail insulators, cable supports, strain insulators, gas-mantle products, solid porcelain reflectors, raised sign letters, cutout bases, rosettes and resistance tube.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued an attractive pamphlet giving a brief history of the material used in transformer construction and calling attention to the improved Type H transformer in the manufacture of which

the described steel is used. This publication is No. 3,687. Bulletin No. 4,611 is devoted to sewing-machine motors; bulletin No. 4,612 describes the combination ammeter and voltmeter for automobile service, and bulletin No. 4,615 the Thomson direct-current test meter, Type CB-2.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a circular announcing a ten per cent reduction in the price of Columbia tungsten lamps. Transportation on standard packages of Columbia tungstens will be allowed east of the Mississippi River, and a small additional charge will be made for delivery to other points. The company's record of breakage for six months amounts to approximately two per cent upon the actual value of the lamps shipped. The company is carrying a complete stock of all sizes and styles of Columbia tungsten lamps.

THE MOLONEY ELECTRIC COMPANY, St. Louis, Mo., has published a very handsome catalogue devoted to its high-efficiency transformers. These transformers are made with great care from material of the highest grade procurable. The design of the transformer permits of the most economical distribution of copper, as well as the use of a sufficient cross-section to carry the current with a minimum loss. The all-day efficiencies of these transformers are very high, and some remarkable qualities have been demonstrated after numerous tests covering every characteristic of transformer performance.

THE JENNEY ELECTRIC MANUFACTURING COMPANY, Indianapolis, Ind., it is announced, will break ground in the near future for a factory at Anderson, Ind., which will, when completed, be four times the size of the present establishment in Indianapolis. This company has been in business for many years, and during the last few years has devoted itself largely to the manufacture of electric motors for printing-press operation. When in its new quarters the company will enlarge its present line of alternating and direct-current motors and dynamos, and will become a more conspicuous factor in the manufacture of electrical machinery.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has issued "Hand Book IP," which is a publication of special interest to dealers and contractors. It treats of the application of the "Chloride Accumulator" to small isolated electric lighting and power plants for factories, residences, etc., where electric service from central stations is not available. It shows how the advantages of a twenty-four-hour electric service are made possible by the use of a battery of "Chloride Accumulators," entering fully into the subject and giving illustrations of the types of batteries and switchboards required for installations of different capacities. Specifications and prices for complete installations are given.

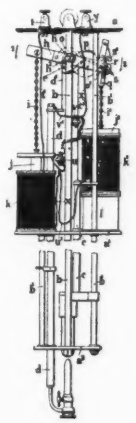
THE STANDARD GAUGE MANUFACTURING COMPANY, Syracuse, N. Y., announces that the Schaeffer & Budenberg Company, of Germany, has sold its plant at Foxboro, Mass., to the Industrial Instrument Company, which was lately organized with Bennett B. Bristol, formerly of the Bristol Company, Waterbury, Ct., as its head. The Standard Gauge Manufacturing Company will operate the plant for the manufacture of gauges, recording instruments, etc., and the property will be deeded to it by the Industrial Instrument Company, as the same interests control both concerns. Watson E. Goodyear, of Naugatuck, Ct., will be president of the Standard Gauge Manufacturing Company; Bennett B. Bristol, treasurer, and Arthur F. Mundy, secretary.

Record of Electrical Patents.

Week of September 8.

897,866. SIGNALING APPARATUS. George F. Atwood, East Orange, N. J., assignor to Western Electric Company, Chicago, Ill. Filed February 26, 1906. The instrument case contains the induction coil, condenser, relays, battery, magneto, switch, springs and ringing system.

897,868. ELECTRIC IGNITION DEVICE OR SPARKING PLUG FOR INTERNAL-COMBUSTION MOTORS. Charles O. Bastian and George Calvert, London, England. Filed June 27, 1906. The ignition device is contained in a removable, renewable glass tube.



897,960.—ELECTRIC ARC LAMP.

897,906. LIGHTNING ARRESTER. Frank P. H. Knight, Keokuk, Iowa, assignor to Electric Service Supplies Company, Camden, N. J. Filed June 28, 1907. Separate paths are provided for the circuit-breaker and the discharge. The circuit-breaker is adapted to open the circuit and close the circuit by the normal current.

897,947. LIGHT FIXTURE. Arthur B. Wilson, St. Louis, Mo., assignor of one-half to George T. Breen, St. Louis, Mo. Filed September 27, 1907. The hollow body is adapted to receive hollow lamp-supporting arms, and is fitted with a flanged brace ring.

897,950. SYSTEM OF ELECTRICAL DISTRIBUTION. Joseph L. Woodbridge, Philadelphia, Pa. Filed January 20, 1908. A rotary converter is connected between the alternating-current circuit and the transforming apparatus, and means are provided for responding to changes of electrical condition in the alternating-current circuit.

897,960. ELECTRIC ARC LAMP. Pierre M. Capitaine, Les Lilas, France. Filed November 11, 1907. Means are provided for varying the adjustment of both carbon-holders by means of series and shunt magnets.

897,965. SYSTEM FOR TRANSMITTING ELECTRIC CURRENTS TO CARS. John J. Eagan, San Francisco, Cal. Filed October 18, 1905. The train is electrically connected by means of mutually engaging rods curving downwardly at their ends to contact with side arms.

898,030. SYSTEM OF REGULATION. Joseph Bijur, New York, N. Y., assignor to the General Storage Battery Company, New York. Filed April 4, 1906. A storage battery is used for compensating variations in the working circuit.

898,052. ELECTRIC ARC LAMP. Robert E. Leve, New York, N. Y. Filed January 22, 1908. The winding drum, brake-shoe and escapement wheel are mounted concentrically upon a single rotatable shaft.

898,055. ELECTRIC BATTERY. William MacMillan, New York, N. Y., assignor of one-half to Egbert Winkler and one-half to John J. Walsh, New York, N. Y. Filed August 18, 1902. The battery comprises a plurality of concentric elements located within a cloth-lined insulating exterior cylinder.

898,058. MEANS FOR REGULATING DYNAMOELECTRIC MACHINES. Wilbur L. Merrill, Schenectady, N. Y., assignor to General Electric Company. Filed February 20, 1906. Means are provided to modify the voltage of the generator of the motor-generator set so as to maintain the speed of the motor constant independent of its load.

898,061. FUSE BOX. Harry P. Moore, Newburyport, Mass., assignor to Chase-Shawmut Company, Boston, Mass. Filed April 8, 1907. The terminals are out of line with the fuse support.

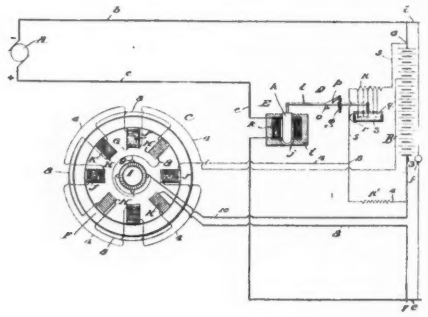
898,073. APPARATUS FOR SPEECH TRANSMISSION. Herbert E. Shreeve, Wyoming, N. J., assignor to American Telephone and Telegraph Company. Filed October 15, 1907. Means are provided for varying the magnetic flux traversing the induction coil.

898,083. ELECTRIC LIGHT FIXTURE. William Amstalden, Amador City, Cal., assignor of one-half to Aaron Weil, Amador City, Cal. Filed December 31, 1907. The lamp cord is contained in a casing provided with a spring-controlled winding drum.

898,086. MULTIPLE ELECTRIC FUSE CUT-OUT. Wilhelm Boehm, Berlin-Charlottenburg, Germany. Filed June 8, 1907. A fuse comprising a plurality of independent sections is contained in an annular chamber and fed as may be necessary through a fuse-containing passageway.

898,095. SIGNAL BOX. Frederick W. Cole, Newton, Mass., assignor to the Gamewell Fire-Alarm Telegraph Company, New York, N. Y. Filed June 10, 1906. Means are provided for the transmission of selected different signals.

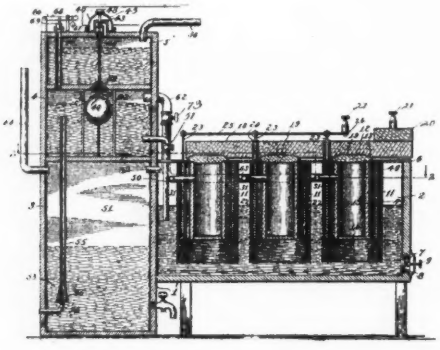
898,097. TERMINAL FOR ELECTRIC CABLES. Charles W. Davis, Edgeworth, Pa., assignor to Standard Underground Cable Company, Pittsburg, Pa. Filed December 23, 1907. A combination multiple petticoat insulator having a conducting core and means for insulating a plurality of separate conductors.



898,030.—SYSTEM OF REGULATION.

898,104. CIRCUIT-CLOSER FOR CALL BELLS. Robert Henderson, U. S. Navy. Filed June 4, 1906. The weighted knob or handle contains a helical spring adapted to effect the closure of a circuit upon any increase of pressure.

898,133. APPARATUS FOR PRODUCING VOLTAIC HIGH-CURRENT ARCS. Harry Pauling, Gelsenkirchen, Germany, assignor to the firm of Salpetersäure-Industrie-Gesellschaft, G. M. B. H., Gelsenkirchen, Germany. Filed July 29, 1907. The arc is formed between a pair of curved electrodes, and means are provided for spreading out the arc in a strong magnetic field.



898,055.—ELECTRIC BATTERY.

898,189. ELECTRODEPOSITION OF ALLOYS. Sherard O. Cowper-Coles, London, England. Filed August 2, 1907. The method consists in employing an anode of the alloy to be deposited, and an anode of each of the metals composing the alloy, and independently varying the current passing through the anodes of the metals of the alloy as desired.

898,195. SUPERVISORY SYSTEM FOR TELEPHONE LINES. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed October 31, 1903. Means are provided in connection with a supervisory relay to deprive the signal system of operating current.

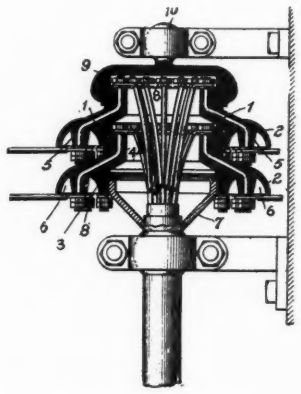
898,197. WIRELESS TELEGRAPH APPARATUS. Halsey Dunwoody, U. S. Army. Filed May 21, 1907. A portable, self-contained radioelectric circuit.

898,216. ELECTRIC RAILWAY CONDUIT. Elmer E. Granger, Chicago, Ill. Filed August 4, 1906. A flexible strip or connector in the conduit is capable of an undulatory movement throughout its length under the influence of polar magnets carried upon the car.

898,218. ELECTRICAL PIANO-PLAYING INSTRUMENT. Alvan L. Hart, Burlington, Iowa. Filed November 29, 1902. The armature operates directly upon its magnets and transmits motion to the hammer.

898,219. RAILWAY ELECTRIC SIGNALING. Job Hutchinson, New York, N. Y. Filed May 10, 1905. This signal is biased to danger, and is normally electromagnetically restrained when its section is unoccupied by a car or train.

898,220. CONTACT RAIL FOR ELECTRIC RAILWAYS. Job Hutchinson, New York, N. Y. Filed May 10, 1905. The rail proper and its flexible cover both afford metal contact with the contact shoe.



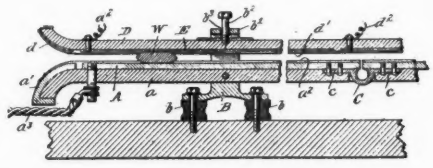
898,097.—TERMINAL FOR ELECTRIC CABLES.

898,221. RAILWAY ELECTRIC SIGNALING SYSTEM. Job Hutchinson, New York, N. Y. Filed January 2, 1906. Means are provided for controlling the signals when the section is occupied by a car.

898,283. TELEGRAPHONE. Harve R. Stuart, Wheeling, W. Va. Filed September 24, 1907. Means are provided for making the telegraphone instrument unresponsive.

898,296. SYSTEM FOR CONTROLLING TRAINS. Paul Winsor, Weston, Mass., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed August 12, 1905. A double-circuit, relay-control block-section signal system.

898,313. ELECTRIC RECORDER FOR ICE PLANTS. William D. Cain and Wade H. Williams, Durant, Okla. Filed May 9, 1908. A detent closes the circuit upon the passage of a block of ice, and causes an index to be made on a dial system.



898,220.—CONTACT RAIL FOR ELECTRIC RAILWAYS.

898,324. ELECTRIC SIGNALING SYSTEM. Elmer R. Coe, Wilkinsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed May 11, 1908. The track rails are provided with a signaling current from a high-potential system with a transformer interpolated.

898,370. HIGH-TENSION MAGNETO. Edward B. Jacobson, Pittsfield, Mass., assignor to Pittsfield Spark Coil Company, Pittsfield, Mass. Filed January 16, 1907. The potential is built up by inductive windings and compound field magnets, with a condenser in the primary.

898,404. PROCESS OF MAKING ARTICLES BY ELECTROPLATING. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J. A coating of copper is electroplated on a former, a film of nickel electroplated on the copper coating, and a film of iron electroplated on the nickel film.